DOCUMENT RESUME

ED 338 826 CE 059 516

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TITLE Occupational and Qualification Structures in the Field of Environmental Protection in the Metal and Chemical Industries--Study on the Federal Republic of Germany.
INSTITUTION European Centre for the Development of Vocational Training, Berlin (Germany).
REPORT NO ISBN-92-826-2015-8
PUB DATE 91
NOTE 66p.
AVAILABLE FROM UNIPUB, 4661-F Assembly Drive, Lanham, MD 20706-4391 (Catalogue No. HX-60-90-313-EN-C: $8.61).
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Adult Education; *Chemical Industry; *Employment Qualifications; Environmental Education; *Environmental Standards; Foreign Countries; Hazardous Materials; Job Analysis; Job Skills; *Metal Industry; *Occupational Information; Physical Environment; Pollution; Postsecondary Education; Vocational Education
IDENTIFIERS *Environmental Protection; *Germany

ABSTRACT

A study focused on new occupational and qualification structures in the field of environmental protection in the metal and chemical industries in the Federal Republic of Germany. A total of 22 interviews were conducted with representatives of 11 firms. The public debate on occupational requirements in the field of environmental protection and on appropriate training for occupations in the field began only recently. Integration of environmental learning objectives into federal training regulations and inclusion of the objectives into the vocational curricula has begun. Typical environmental problems faced by the chemical and metal industries are dangers posed by solvents, heavy metals, and use of oils. A supply-side view of occupational and qualification structures in the field of environmental protection focused on the qualifications "produced" for environmental protection in firms. Two factors affecting the development of qualification structures were inclusion of subjects relevant to the environment in existing training courses and separate, formally distinct additional training in environmental protection. The demand-side analysis established what kind of work requirements environmental protection entailed, whether and how these were combined to form tasks, and what qualifications were needed to perform those tasks. A four-field matrix was developed that permitted an initial typology of requirement profiles in environmental protection. A phase model was also designed that covered all tasks for ensuring that the environment was protected. (Appendixes include a 44-item bibliography and the interview guide.) (YLB)

ED338826

CEDEFOP Document

Occupational and qualification structures in the field of environmental protection in the metal and chemical industries

Study on the Federal Republic of Germany

European Centre for the Development of Vocational Training

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Occupational and qualification structures in the field of environmental protection in the metal and chemical industries - Study on the Federal Republic of Germany

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First edition, Berlin 1991

Published by:

CEDEFOP — European Centre for the Development of Vocational Training
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Telex: 184 163 eucen d

The Centre was established by Regulation (EEC) No 337/75 of the Council of the European Communities

Cataloguing data can be found at the end of this publication

Luxembourg: Office for Official Publications of the European Communities, 1991

ISBN 92-826-2015-8

Catalogue number: HX-60-90-313-EN-C

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Printed in Belgium

Preface by CEDEFOP

One of CEDEFOP's main tasks is to cooperate with the Commission of the European Communities in carrying out national and comparative studies of existing and emerging occupational and qualification structures within certain groups of occupations in the most important of the Member States' industrial, trade and service sectors. The findings of these studies are being used to compile an inventory of occupational and qualification structures relevant to the labour market, which is intended both to increase the transparency of the qualifications that will be needed in a future European labour market and to form the basis for the design or updating of initial and continuing training curricula.

These studies also focus on the emergence of or changes in occupational and qualification structures as a result of measures taken in all leading sectors of the economy to protect the environment, especially as all the relevant forecasts indicate that the demand for specific qualifications in the field of environmental protection will increase significantly in the European Community in the next few years.

However, as it would be beyond the scope of the overall project for all the industries examined by CEDEFOP to be made the subject of separate studies aimed at identifying occupational and qualification structures relevant to the environment, we have begun by selecting two sectors in which the protection of the environment is becoming a special challenge: the metal and chemical industries. Our next step will be to extend this research to the public services.

Studies of the metal and chemical industries, which have now been completed, were commissioned in four Member States (Italy, the Netherlands, the Federal Republic of Germany and the United Kingdom). Despite the very short time allowed and financial restrictions imposed by CEDEFOP, which did not permit a representative approach, these studies reveal a wealth of different, yet comparable, findings on changes in occupational

and qualification structures and the emergence of new, environmental occupations.

This has required considerable personal commitment on the part of the authors, and we would like to take this opportunity to thank them for their efforts.

The findings of these studies will be summarized in a report containing comparative tables of the most relevant occupational and qualification structures in the four countries. It will be published in late 1991 (in English, German and French).

Finally, where they have access to appropriate research findings, the Member States which have not participated in this project are urged to draw up reports on occupational and qualification structures in the field of environmental protection in the same industries in their own countries, adopting the same approach as in this and the other studies.

Enrique Retuerto de la Torre
Deputy Director

Gesa Chomé
Project Coordinator

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1. Background and methodology

This study on the Federal Republic of Germany (including West Berlin) forms part of an international comparative study on new occupational and qualification structures in the field of environmental protection being carried out for the European Centre for the Development of Vocational Training, Berlin. The study focuses on the chemical and metal industries, which are of major importance in both economic and ecological terms. Similar studies are being conducted in the United Kingdom, Italy and the Netherlands as selected Member States of the European Community.

Under CEDEFOP's guidance all concerned in the project have agreed on a number of basic methodological features. Particular mention should be made in this context of the adoption of the methodological concept of "occupational and qualification structures" (with the two main elements "core tasks" and "competences"), the central theme of a larger research project being undertaken by CEDEFOP concerning the development and comparability of training courses and jobs in various sectors of the economy. It was also agreed that the basic information base should be obtained primarily from interviews with experts in selected companies.

The study breaks new ground in research. Although various papers on training for occupations in environmental protection have been published in the Federal Republic of Germany, they must be seen rather as basic research or initial stocktaking of what training is available. How the mounting environmental problems and the ecological challenge are reflected in occupational requirements and how vocational training profiles are responding to these requirements are questions that have been hardly broached, let alone studied in any depth. (Exceptions are the occupational and qualification structures of the "water supply and waste disposal technician" and the "environmental manager", various aspects of which have already been the subject of more detailed analysis.) This study can thus claim to do no more than make an initial exploration of problems and patterns of action in firms in this field.

The pilot nature of the study is evident not least from the fact that only two man-months were set aside for the project. The resulting small size of the sample makes it even more difficult to establish typical patterns of action by firms (and individuals) in what is for them still an atypical area of activity. The minimum criterion applied in deciding on the composition of the sample was therefore that firms should have clear-cut and typical environmental protection problems, since it was felt that the topicality of environmental protection in industry was also likely to have implications for the development of occupational and qualification structures, an assumption which is indeed backed by evidence (see Nitschke 1989a for the link between views on environmental protection and environmental training activities). Selecting firms on the basis of typical problems was facilitated by the conclusion drawn in earlier studies and interviews with researchers (see Annex 3) that many environmental problems affect a wide range of firms, sectors and industries.

The sample comprises eleven firms (see Annex 1). Access to them was gained through existing contacts and through pertinent information obtained from industrial organizations (chambers of industry and trade, the Rationalization Board of German Industry/Berlin Section, Industrial Association), environmental consultancies and a body providing continuing training in environmental protection (list of participants in a working group on environmental protection at the Berlin Centre for Further Training in Health and Environmental Protection [FGU]). Of the firms approached orally or in writing with a request to cooperate in the study, about half refused to participate. The reasons given were that the potential interviewees were too busy, on personal leave or on leave during the firm's annual shutdown (this being particularly true of automobile manufacturers), but there was also a fear that the interviews might reveal excessive shortcomings in efforts to protect the environment. In a way one of our selection criteria, the handling of problem situations, was thus a direct cause of non-selectability.

The sample does not include any small firms. Their absence is due to experience in comparable studies (as confirmed in the interview with LONGOLIUS) and the repeatedly expressed view and our own experience that small firms "have little to offer" in the area of environmental protection. The method used to select firms is also to blame, small firms being, for example, generally less active in their associations and rarely deputing employees to attend courses of further training.

The interviews in the firms were conducted on the basis of a guide with an open structure (see Annex 2). As it was essential to obtain relatively sound information on environmental protection measures taken in the firms, their environmental experts certainly had to be interviewed, even though our interest extended well beyond this specific group. However, a number of "normal" employees were also interviewed so that selective information might be obtained "at first hand". The questions in the guide thus concerned general background information, the relevance of various jobs in the firm to the environment and the jobs of the persons interviewed.

Accordingly, and in view of the limited duration of the interviews (one to three hours), the main topics varied widely. A total of 22 interviews (see Annex 1 for the serial numbers) were conducted with representatives of firms. Of these, 15 took the usual form of individual interviews "on site". One interview was restricted to an hour-long discussion on the telephone (12). Two interviews were conducted with two people simultaneously (2a and 2b; 3a and 3b). A further interview unfortunately took place in the partial absence of the superior (6b), and the interview with one environmental manager (5a) was attended by a member of the management board. Some interviews were combined with plant inspections.

The sample is already somewhat distorted by the numerical dominance of experts (with respect to occupational and qualification structures directly recorded), and a further lack of clarity arose from the fact that, despite their status, some of these experts were able to say little about what was actually required of individual occupational families in

environmental protection. At best, this could have been remedied by observations of workplaces, in addition to interviews with the workers concerned. A reference must also be made to the impossibility of gaining more than a superficial impression of measures actually taken to protect the environment. This was due, on the one hand, to the sensitive nature of the subject, which raises the problem of interviewees trying to cultivate their image or to gloss over deficiencies (where it has not already prevented access to the firm). This aside, however, far more intensive questioning and a wider specialized knowledge would have been needed in many cases for a proper assessment of the information provided by the interviewees on improvements in environmental protection.

To enable the interviews to be evaluated, notes were kept, some detailed, some consisting of only the salient points, and entered in forms at a later stage. This enabled both individual cases to be examined and cross-section comparisons of specific aspects of different individuals and firms to be made. Besides the interviews with firms, a number of discussions were held with research experts, and some information was obtained by telephone (see Annex 3).

The research report consists of three parts. Chapter 2 contains a number of comments on the importance attached to vocational training in environmental protection in the Federal Republic of Germany and an outline of typical environmental problems occurring in the chemical and metal industries and in the firms studied. Otherwise, the two sectors are not considered separately, since this would run counter to the basic lines of differentiation in our approach to the matter in hand, and because, in many cases, no specifically sectoral information is available. Chapter 3 begins by briefly reviewing occupational and qualification structures in the field of environmental protection from the "supply side" of training courses in this field. This is followed by the main part of the study, the description and evaluation of the interviews primarily from the "demand side". Finally, the two sides of the analysis are brought together in a résumé. The report ends with a number of conclusions and demands.

2. An overview of general conditions at national level

2.1 The public debate on occupational and qualification structures in the field of environmental protection

As already indicated, the debate in the Federal Republic on occupational requirements in the field of environmental protection and on appropriate training for occupations in this field began only very recently. In both academic and practical political terms the subject forms the point of intersection of three lines of discussion: the pedagogically slanted debate on "environmental education", which owes its name to the dominant tradition in this field, the debate on vocational training and the debate on environmental protection in industry or the world of work.

The last of these debates, to which firms and industrial associations are themselves increasingly responding, does not, however, focus on training

and personnel or on the organization of work. "Environmental protection is the employer's responsibility" is the slogan of the day, the environmental technology market is booming, and such functional areas in firms as procurement, marketing and even manufacture have clear priority. Nor can the problems posed by ecological innovations in this context be solved unless certain training requirements are met. Meeting these requirements and combating the general destruction of the environment with increased efforts in ecologically oriented initial and continuing training is a matter for a few and, above all, large enterprises.

While the debate on environmental issues in vocational training is on the whole similarly still in its early stages, learning about the environment, largely as part of general education, began in earnest some 15 years ago. Like most other European countries, the Federal Republic of Germany participated in UNESCO's worldwide programme of "Environmental Education" from the outset. In the international history of environmental education associated with this programme the Tbilisi conference in 1977 was a milestone, providing a crucial stimulus in the western part of Germany and leading, among other things, to the establishment of the UNESCO Environmental Education Liaison Office attached to the Federal Environment Agency in Berlin (see Lob, 1989).

Although the Federal Republic is considered to be one of the "leaders" in environmental education (see, for example, Lob, 1987 p. 290), a great deal has yet to be done to make environmental issues a standard part of teaching in the non-scientific subjects and to improve the organization of teaching and teaching methods in this respect (for a summary see Nitschke 1989a, p. 40).

The shortcomings in vocational training and, to some extent, at the universities are far more serious. This statement is not refuted by the significant increase in activities in this area since the 1980s. The most important government agencies, such as the Federal Ministry of Education and Science, the Federal Institute for Vocational Training, the Federal and Land Commission for the Planning of Education, the Conference of the Education Ministers of the Länder and the various Land Ministries of Education (which are responsible for vocational training) have developed programmatic positions, amended framework directives to cater for environmental protection and promoted a few practical approaches. The education authorities themselves are taking growing account of environmental protection in the education they provide.

On the one hand, then, the above-mentioned point of intersection, where education, employment and environmental protection meet, still lies in relatively fallow land. On the other hand, the increase in initiatives cannot be denied, and their main practical implications will be briefly mentioned in the following.

Firstly, there is the "integration" of environmental learning objectives into the Federal training regulations (in over half of the occupations for which new regulations were issued between 1971 and 1984; see Paul et al. 1984) and the inclusion of these objectives in the framework cur-

ricula of vocational schools. A number of special training courses in environmental protection have also been introduced (e.g. water supply and waste disposal technician as a first training choice; post-graduate courses in environmental protection). The first pilot projects are under way in firms and schools. Teaching materials have been developed for certain occupational fields. Over 200 continuing training institutions offer courses in environmental protection. Of the 50 largest industrial enterprises in the Federal Republic, about 15 have introduced continuing training in this field. Such labour market policy instruments as job creation measures in the field of environmental protection and the promotion of further training courses lasting several months to several years (e.g. "environmental adviser", "environmental protection specialist") complete the picture (see Nitschke 1989a; Federal Institute of Labour 1990; Federal Environment Agency 1988).

These examples will suffice for an initial assessment of the importance attached to the development of occupational and qualification structures in the field of environmental protection. Some of the approaches will be considered again when the "supply side" is discussed.

2.2 Environmental problems in the chemical and metal industries

If it is assumed that environmental problems in the sectors of industry of interest here are "international", the "national" nature of general conditions relates at best to the interpretation and assessment of these problems from a specific cultural angle. The scale of cultural traits is not the subject of this study.

2.2.1 Chemical industry

Without a doubt the chemical industry is one of the main sources of the "pollutant of the month". It has also hit the headlines after spectacular accidents, and it is way ahead of the field when it comes to, say, special waste (for the latter aspect see Katalyse 1988, p. 319). It thus presents particularly clear-cut and topical problem situations for a study to tackle.

However, it can be assumed that a wide variety of typical environmental problems very probably occur in every firm in the chemical industry: for one thing, the whole of this industry is relevant to the environment because of the substances with which it works; for another, almost every firm manufactures a wide range of products. A typical large enterprise will produce as many as 4,000 to 6,000 products (see Katalyse 1988, p. 85). To this must be added the hundreds of thousands of substances which happen to occur during manufacture as "complementary products" (interview with KRAEMER). Closely associated with this is the fact that many chemical products have a basic raw material in common, 70% of them today being derived from petroleum (interview with LONGOLIUS). Thus, given the interrelated nature of chemical processes, individual substances and environmental problems for which they are allegedly respon-

sible can hardly be considered in isolation. These links also characterize the economic structure of the chemical industry, which, instead of having (sub)sectors, is broken down into lines of business, particularly in medium-sized and larger enterprises. This is not least evident from the organization of the Association of the Chemical Industry (LONGOLIUS).

A typical problem throughout the chemical industry is posed by the use of such solvents containing chlorinated hydrocarbons (CHCs) as benzene and carbon tetrachloride. They are used as aids in industrial production (e.g. the paint, adhesive and textile industries). They are ecologically dangerous because of their incompatibility (toxic vapours even at the time they are used, degradable only with difficulty in nature, enrichment in organisms, suspected of being carcinogenic) and because of the quantities in which they are used (see Katalyse 1988, p. 214). In the chemical industry they are used in far larger quantities than the substances to be dissolved (interviewee 1a), which is also clear from their major contribution to the volume of special waste (see Katalyse 1988, p. 319).

These solvents epitomize environmental problems in the chemical industry, the comprehensive nature of which has been referred to above. Firstly, they represent one aspect of the problem posed by CHCs, organic chlorine compounds, which in the debate on chemical policy have been referred to by Lahl/Zeschmar-Lahl (1988, p. 178), for example, as the most significant unnatural structural element of all. CHCs are also used in many other products, e.g. plant protection agents, PVC and chloroform. CHCs also represent a sub-problem in chlorine chemistry which LONGOLIUS and KRAEMER consider to be the chemical industry's main problem, since 80% of all chemical intermediate and end products contain chlorine. PAUL feels this criticism goes too far: he would prefer to see the emphasis placed on the sub-set comprising highly chlorinated hydrocarbons. He also considers inorganic chlorine chemistry to be less dangerous in terms of accidents.

Once chlorine chemistry has been questioned, it is not long before fundamental ecological criticism is levelled at the chemical industry as a whole. It is commonly accused in this context of "emitting harmful substances and products", meaning that many chemical products are in themselves harmful to the environment and/or unnecessary (the use of heavy metals, plastic packaging materials; the whole of chlorine chemistry as a result of the reprocessing of chlorine as a waste product). This being the case, chemistry as a branch of science and laboratory practice can also be questioned (synthetic chemistry, which releases unnatural substances into the environment before they have been properly tested and so causes at least as many problems as it solves). The key words here are criticism of the "hard methods" (work at high pressure and temperature) and the appeal for "soft chemistry" (see Gleich 1989).

"End-of-pipe" environmental protection technology appears to work very satisfactorily in the chemical industry (used air incinerators with flue gas washing; large waste purification units with mechanical, biological and chemical purification stages). KRAEMER, however, sees such measures merely as putting the "lid on the barrel", and LONGOLIUS refers to over-

compensating for the effects of technology by increasing volumes (which in the end often increases emissions). In this area problems are often simply shifted to another aspect of the environment (see Gleich 1989, p. 103). The problem of plant safety has, according to LONGOLIUS, been largely solved (apart from the recognition of industrial diseases). A large grey area that remains is the question of what happens to the innumerable principal and subsidiary substances used by a typical chemical plant. KRAEMER refers to admixtures to products below the level at which they are noticeable, which Gleich describes as "smuggling in". (A grotesque example of this is the "disposal" of paradichlorobenzene through the sale of toilet fresheners to private households.)

2.2.2 Metal industry

The metal industry consists of various sectors, in which pollution occurs to widely varying degrees. This is evident, for example, from the volume of special waste (e.g. saline slags, lyes, used oil), where the non-ferrous metal industry leads the field with 320,000 tonnes a year. It is followed by the engineering industry (130,000 tonnes), the automobile industry (109,000 tonnes), the iron and steel producing industry (108,000 tonnes) and the iron goods, sheet metal and hardware industry (91,000 tonnes) (see Katalyse 1988, p. 319). Another indicator is investment in environmental protection. While this is almost entirely confined to air conservation measures in the non-ferrous metal industry, expenditure on waste water treatment dominates in the surface refinement/hardening/steel-forming sector (see Nitschke 1989b, pp. 31 ff., with specific reference to Berlin).

There are undoubtedly major problem areas in the metal industry. They include foundries and high-temperature production processes in general and also electroplating (ibid.; see Katalyse 1988, p. 224). In terms of dangerous materials, however, pollution across the board can again be identified: metal dusts (asbestos, nickel and chromium occurring, for example, during grinding, welding and paint-spraying), coolant-lubricants used during the shaping of metals, certain kinds of surface treatment (e.g. acid, chrome and nickel baths) and the above-mentioned solvents used to clean and degrease work pieces, trichloroethylene and perchloroethylene being notorious examples. Dipping baths are normally used for the last of these processes. The handling of emulsions (lubricants) and (other) liquids containing CHCs is both an industrial safety problem (inhalation of toxic vapours and oil mist) and above all a waste water problem. In principle certain requirements have to be satisfied with respect to disposal (sedimentary sludge, used oil), reprocessing (recovery in distillation units; regeneratable hardening baths; emulsion-splitting units) and, ideally, avoidance (substitution of aqueous systems for solvents; non-use of solvents containing CHCs [ECKHARDT]).

The widespread use of solvents containing CHCs is revealed in a study carried out by Industriegesellschaft Metall in Baden-Württemberg, according to which almost half of all metal-working firms still use perchloroethylene or related agents today (see Linkersdörfer 1988). Interviews

with employees in the metal industry also show that for the vast majority it is a common experience to be confronted with dangerous working materials (see Köhler 1987 pp. 33 f).

2.2.3 Implications

The chemical and metal industries, and presumably many other sectors, obviously have a number of problem areas in common, an example being the dangers posed by solvents. (Whether it is therefore at all appropriate to consider environmental protection issues at the level of sectors rather than, say, groups of substances is not a question which can be pursued further here). The general nature of the problems can also be inferred from the fact that the largest enterprises in the chemical industry, for example, train over a third of their trainees in industrial and technical occupations (and they then go on to work in plant construction or maintenance). The problems will become even more general in the future as the influence of chemistry on technology grows and the use of "new composites" (glass fibre reinforcement, plastic coatings on metals) becomes more common.

The problems outlined here are very largely reflected in the pollutant factors mentioned by the representatives of the firms included in the sample (see Annex 1 for their products). Problems associated with given substances are common to several firms and several sectors. This is primarily true of the use of solvents, which are needed in the manufacture of adhesives (U9C), for cleaning and degreasing (especially U3M, U7M, U8M, U11M), for paints (U2M, U3M, U7M, U9M, U11M), for printing and marking inks (U3M, U10C) and generally for the processing of basic chemical substances (e.g. the "formulation" of pharmaceuticals at U1C and U10C).

Another problem is posed by heavy metals, which are filtered out of the treated waste water occurring, for example, in electroplating, phosphatizing and anodizing processes, leaving sedimentary sludge (U6M, U4M, U7M, U8M, U10C). Reference can also be made to the widespread use of oils, which gives rise to used oil (U2M, U4M, U7M, U8M), used drilling emulsions or coolant-lubricants (U4M, U7M, U8M) and oily cleaning rags (U2M, U7M, U8M). Chips too are a typical waste product of metal-working processes at the firms interviewed. It must be admitted, however, that certain problems occurring in metal production (of which there is none in Berlin) and the large-scale production of chemicals are not covered by the sample.

3. Analysis of functions and structures

3.1 Supply-side view

Just as any occupation is normally both learnt and performed, occupational and qualification structures in the field of environmental protection have a side representing learning and what is learnt and a side representing application and what is required. To use the terminology of eco-

nomics, we can also refer to the "supply side" and "demand side" of occupational and qualification structures. The distinction between "competences" and "core tasks" in CEDEFOP's approach takes account of these two sides.

For this reason alone, it is worth considering the supply side of occupational and qualification structures in the field of environmental protection. This can also be expected to provide some clues to features on the demand side, since the training provided for and by industry would have little point if it did not largely meet actual needs.

How, then, does the supply side contribute to the development of occupational and qualification structures in the field of environmental protection in the chemical and metal industries? This question will be discussed in the following, but only in the form of a rough outline and on the basis of a number of examples. A disadvantage in this respect is that little information is available on the areas in which the products of vocational training are actually employed.

A basic distinction can be made between two variants in the development of structures. The first consists in the inclusion of subjects relevant to the environment in existing training courses. The second amounts to separate, formally distinct additional training in environmental protection.

3.1.1 Environmental protection as integrated vocational training

Environmental protection is being integrated into a wide variety of initial training and continuing training. This integration varies in range and in the extent to which it is compulsory. The environment-related optional and compulsory subjects introduced in some university departments and courses are a typical example of very partial integration, since they are not binding on anyone and affect only those who study at a university specializing in the environment (e.g. environmental protection as part of a chemistry course at a technical college, environmental economics in a university economics department). At universities in particular it is, moreover, not always easy to distinguish integrated and separate courses (as in the case of "extension courses").

Another example is full-time training in the occupations of biological technical assistant and chemical technical assistant at the Rhenish Academy in Cologne. These courses make it possible to specialize in environmental protection (e.g. environmental analysis, basic ecological knowledge, environmental law), an opportunity that has been seized by some 270 students since the courses were first introduced. According to information obtained during telephone interviews, biological technical assistants are also employed in the metal and chemical industries, particularly in analysis.

In contrast, the inclusion of environmental subjects in training regulations, which govern vocational training under the dual system, in line

with the "integration principle" is formally binding on all concerned. Of particular interest in the context of this study is the reorganization of occupations in the natural sciences (skilled chemical workers, chemical, biological and paint laboratory assistants) and in the metal and electrical industries (especially industrial, machine tool and machining operatives) to take account of environmental protection.

Integration may vary in depth. It is most firmly rooted when environmental protection not only adorns the "training career profile" but is also specified in the outline training plan, intermediate and final examinations and the outline curricula of vocational schools. This is true of all science occupations in which training is provided.

Under the outline training plan trainees are required to learn, through "constant teaching" during the first year of their basic vocational training,

- "to provide information on possible pollution and means of avoiding and reducing it,

- to refer to occupation-related arrangements to protect the environment,

- to take steps to avoid and reduce pollution (and)

- to collect and store wastes and residues in accordance with waste disposal regulations."

The environmental idea is also to be found in other "skills and knowledge to be taught" as part of the training plan, such as the "rational use of energy" and evidence of knowledge of "hazard symbols and the marking of dangerous substances" (see BMW/BMBW 1987a). The outline curriculum sets aside 30 hours for environmental protection in the first year of training.

The reorganization of occupations in the metal industry reflects a general and extensive adjustment of occupational and qualification structures to changes in technology and organization, which has resulted in 37 more or less "obsolete" occupations giving way to six new occupations with 16 subject areas. The depth to which environmental protection is integrated in this case is more limited (no relevance to examinations; no requirements to be met by schools). The training outline in this respect is combined and reads for all subject areas: "industrial safety, environmental protection and the rational use of energy".

The outline training plan incorporates environmental protection as a subject in which "skills and knowledge, including independent planning, implementation and monitoring, are to be taught (throughout basic training)". This wording acknowledges the significance of competence to take action. Specifically, proficiency in the field of environmental protection requires, among other things, a knowledge of the hazards emanating from, say, poisons, vapours and gases; a knowledge of legislation relat-

ing to protection against immissions, the prevention of air and water pollution; a knowledge of means of avoiding pollution emanating from the workplace; and a knowledge of ways of conserving energy in the individual's own personal environment. In the metal-working occupations too, many training aspects relevant to the environment are inherent in other learning objectives (e.g. proper maintenance of machines and equipment).

If the integration principle were applied consistently to the depth prescribed in each case, the main occupations in the metal and chemical industries could be said to have "gone ecological" throughout the country. In practice, however, many firms and trainers are lagging behind the statutory requirements (overwork; lack of interest). This is particularly true of small and medium-sized firms and was also revealed by the survey carried out for this study.

Taken as a whole, public pressure means that the large enterprises in the chemical industry are likely to be most consistent in observing the regulations (for details see Nitschke 1989a). Bayer, BASF, Hoechst, Henkel and Schering are well known for the training they provide in environmental protection. Particularly worth mentioning is the development of training aids at Hoechst, where the "Environmental Protection Protocol", for example, is intended to make environmental protection a permanent and systematic work guide. Surprisingly, this protocol plays virtually no part at U5C, even though this firm is almost entirely owned by Hoechst. Also worth noting is the pilot project at Schering (U1C) known as "Elements of the general training of trainers and trainees in the chemical industry with the emphasis on ecology and social learning". In an initial pilot group of 80 trainees and a similar number of trainers in four occupations one of the aims is to overcome professional narrow-mindedness, to encourage holistic learning methods and to shed light on environmental protection from the personal, social and economic angle.

Another example in the chemical industry that should be mentioned is AURO, a manufacturer of natural paints, whose trainees are required to complete not only the traditional curriculum but also one of equal importance concerning the chemistry of natural substances and are given ample opportunity in the firm to learn about the ecological aspects of whole "product lines". This is undoubtedly the most extreme case of ecologically oriented "profiling and shaping" of traditional occupations.

Although Ruhrkohle AG does not form part of the metal industry, it is training men who used to be known as fitters for the successor occupation of industrial mechanic specializing in plant technology. The curriculum sets aside 80 hours, or 9% of the total, for "environmental protection and rational use of energy".

Regulations concerning further training need not be discussed here, since environmental protection currently plays little part in them.

3.1.2 Environmental protection as a separate training course

Water supply and waste disposal technicians

In recent years environmental protection has led to the emergence of new career profiles in both initial and continuing training. In initial training the occupation of water supply and waste disposal technician already mentioned several times is the first instance of an "environmental occupation" being made a "recognized training occupation" (under the dual system). The creation of this skilled worker occupation in technical environmental protection in 1984 was due to the raising of (legal and social) environmental protection standards. However, it can also be ascribed to the progressive introduction into industrial plants of technology which called for specific training to ensure that equipment was operated and supervised safely and responsibly. The workers formerly employed to perform these functions (electricians or metal, construction or chemical workers and assistants with prior technical training, who were taught to do the job) were unable to meet the more stringent requirements (see Handelsblatt of 6/7 July 1984).

Training to become a water supply and waste disposal technician takes three years and, as it combines theoretical, practical, analytical and manual skills, is relatively demanding (according to the Federal Institute for Vocational Training, the water supply and waste disposal technician is a "cross" between a skilled worker and an engineer). The training is divided into three one-year sections, one of the three subject areas "water supply", "waste water", and "waste" having to be chosen in the third year. Trainees are taught, for example, skills and knowledge relating explicitly to industrial safety, health and environmental protection and the rational use energy, the use and maintenance of tools and equipment, the processing of materials, the separation and cleaning of materials and the performance of installation work. The training also covers measuring techniques, the identification of substances and basic knowledge of water supply, drainage, waste water purification and waste treatment.

On the quantitative importance of the occupation it can be said that the number of training contracts has increased significantly. In 1989 some 2,000 people, 10% of them women, were in training (figures quoted during a telephone interview with UHE; see also the relevant passages in BIBB 1989). The subject area "waste water" attracts most interest (66% of the training places). Only about 10% of the training contracts have been concluded with firms in the private sector.

By far the most trainees (90%) so far have gone on to employment in the public service (especially with local authorities). No representative information on those who find employment in industry is available. The prospect of being employed as a qualified water supply and waste disposal technician in the chemical industry varies from one firm to another. Some chemical firms will use only their own skilled chemical workers after one to two years of practical experience. However, others employ newly qualified or retrained water supply and waste disposal technicians.

Yet others are now providing training themselves (BASF; in the metal industry Körber in Hamburg-Bergedorf and Mercedes-Benz in Gaggenau).

Industry often justifies its reservations by referring to the overly theoretical nature of the training and the lack of attention paid to "waste" and "special waste". Where water supply and waste disposal technicians are employed in the private sector, the chemical industry and electroplating and metal-processing firms are regarded as typical employers (see TÜV, p. 11). As for the specific areas in which they are employed, reference can only be made to a survey of graduates of the courses run by one of the largest trainers, who is not, however, an industrial employer. It reveals that most water supply and waste disposal technicians (40%) work on purification plants (of local authorities and in industry), the next most frequently mentioned areas of activity being laboratories (13%), water recovery plants (9%) and waste disposal sites (8%) (see ZAWA, which also refers to what is felt to be the unsatisfactory quality of on-the-job and laboratory training despite an otherwise high level of job satisfaction).

Besides the application of the above-mentioned aspects of training, the tasks of water supply and waste disposal technicians comprise the independent supervision of technical equipment, the analysis of important processes, the development of measures to prevent the occurrence or reduce the quantities of harmful substances and wastes and the documentation of incidents (see TÜV, p.3). In very general terms mention must also be made of the skilled preliminary work they do to enable environmental managers to perform their tasks. With appropriate practical and on-the-job experience or higher training, water supply and waste disposal technicians are able to take on posts in middle management or as plant managers (especially in small or medium-sized firms).

Training at schools and universities

At university level the course at the Technical University of Berlin leading to the title of environmental technology engineer has created the first "environmental occupation". The course enables students to specialize in certain aspects of the environment. Since it was first introduced, some 700 students have graduated, although only about a third of them are now employed in industry, primarily in research and development and in environment departments (no details on sectors of industry; information obtained from the university department and graduates). Although some importance is already attached to such aspects as interdisciplinary thinking and social skills, efforts initiated by the students themselves because of practical shortcomings that have been encountered are currently being made to bring about radical changes in the career profile and forms of learning with a view to arriving at a comprehensive view of the training (project-based instruction, theory of science, criticism of the prevailing treatment of nature, debates on social policy, competence to take action relating to the environment).

In addition to a number of other specific courses introduced more recently at technical colleges ("environmental protection - environmental technology", "process and environmental technology", "supply and energy technology"), universities now offer a wide range of courses which include environmental protection (e.g. energy and environmental technology as part of mechanical engineering courses) and post-graduate courses (e.g. environmental protection, energy technology). For many of these courses industry is quoted as the subsequent employer, though on the whole far less frequently than authorities, planning offices, etc. Many of the courses that focus on environmental protection are explicitly described as training the student for employment in environmental protection in industry (e.g. a course in instrument-making and process technology accompanied by a course in environmental technology is regarded as evidence of the expert knowledge needed for the post of plant manager responsible for protection against immissions; this is also discussed later in this study; see Federal Environment Agency 1990).

In vocational training at schools "environmental occupations" are also gaining ground. An example is the two-year course for "environmental protection assistants" at Bückeburg.

Continuing training

In continuing training a distinction is normally made between further training and retraining (for a new occupation). The only occupation for which retraining is available is again that of water supply and waste disposal technician. Like initial training, the retraining course, which usually takes two years and is partly funded by the employment offices, is broken down into several sections with a rising level of specialization and covers both chemical analysis and manual skills. The people retrained in this way, estimated at 250 to 400 (according to UHE during the telephone interview), appear to be in some demand in electroplating firms in the metal industry (interview with PAUL). One of the firms included in the survey (U8M) employs a person retrained in this way.

In the case of further training (in environmental protection) a distinction can be made between the type that leads to a new vocational certificate and the type that leaves the career profile (outwardly) unchanged. The only master craftsmen produced by the first type are water supply and waste disposal foremen (after three years of practical experience) and, indirectly, specialists in heat and refrigeration technology, a course which can be taken at Ludwigshafen. Further training leading to the qualification of state-certified environmental technologist should also be mentioned in this context. Well-known in this field is the Technical College for Environmental Technology in Frankenberg (where training in metal-working occupations is a typical admission requirement). Once again, there is no published information on the employment of graduates.

The College of Technology at Landau trains "environmental technology assistants". This course is intended as a supplement for chemical technical assistants. A representative of the college says that so far about

40 people have completed the course and gone on to work mainly in the chemical industry and with environmental agencies. Finally, there are courses for "environmental protection specialists", in which unemployed university graduates can obtain a sound, additional qualification.

While the abovementioned types of further training are characterized by the fact that they take some considerable time and are "academic" in nature in that they are off-the-job, the second variant takes place on-the-job. It also entails attendance at specific training institutions, of course, and in some cases it even leads to the award of recognized certificates, which do not, however, fundamentally change the career profile. The courses in which trainees acquire the "expert knowledge" that is required by law along with personal "reliability" for the post of environmental manager are the most important example in this respect. These courses normally last five days.

In practice, many operators of plants or stationary waste disposal facilities requiring official authorization and many firms that discharge waste water, both of whom are required to employ environmental managers in certain circumstances, do not have employees with prior training that meets the requirements. According to the first major survey of environmental managers, 20% of those interviewed did not meet the formal requirements (see Repennig 1986). (Unless they have attended one of the abovementioned courses, environmental managers are deemed to have expert knowledge only if they have a science or engineering degree and two years of practical experience, if they have taken a course in environmental technology and have one year of experience or if they have passed a master craftsman's or technical college examination and have up to four years of practical experience).

On-the-job further training also includes the whole range of courses (evening seminars, one-day courses, conferences, etc.) which are offered by firms themselves or by the many continuing training bodies, primarily concern aspects of environmental law and environmental technology and are often highly specialized. For such strategically important target groups as foremen and plant managers some large enterprises, such as Bayer AG, have established proper programmes of further training, which take up to twelve days.

As it is of direct interest in this context, the course in "waste water treatment in metal-processing firms" run by the Bavarian Factory Inspectorate can be singled out as an example of relevant further training. According to a representative of this inspectorate, the participants are typically environmental managers working in laboratories, central services and staff posts.

It would be beyond the scope of this study to discuss the wide variety of these further training courses in greater detail. To conclude, reference will therefore be made to the hitherto unique case of the arrangements concerning the right of certain groups of employees to information and further training which were initiated by management and labour in the chemical industry two years ago and have since been laid down in legally

binding agreements by over 20 firms. One result of these arrangements has been the establishment in Frankfurt of the Society for Informing Works Councils on Environmental Protection in the Chemical Industry, where several hundred work councils have so far received training (see also Schultze 1989).

3.2 Demand-side view

3.2.1 Environmental protection as an occupational requirement: an overview

While the supply-side view focused on the question of the qualifications "produced" for environmental protection in firms, the aim of the demand-side analysis is to establish what kind of (work) requirements environmental protection entails, whether and how these are combined to form tasks and what qualifications are needed to perform these tasks. The demand-side approach needs to be divided into three steps. Firstly, the aim is to describe environmental protection as an objective and requirement for the firm as a whole, since conventional analyses of occupational and qualification structures concern traditional activities in firms, and environmental protection is a new area of activity for them. The second step is to outline the ways in which environmental protection is organized. Only as the third step will the aim be to describe specific requirements and functions, the features of which will be enumerated in several stages.

Features of environmental protection in firms

Environmental protection in the firms studied pivots on environmental technology. This is evident from an assessment of all the information provided by the experts interviewed at the firms. Typical variants of the measures taken are:

- downstream collection ("end-of-pipe" technology), e.g. filter units, extraction devices, distillation and waste water treatment facilities;
- process innovations which reduce the consumption of dangerous substances;
- process innovations which create closed circuits and permit partial reprocessing of the substances used, e.g. closed water circuits in air-conditioned factories.

The direct consequence of heavy concentration on end-of-pipe measures is the extreme importance that must be attached to disposal. Accordingly, waste, and particularly special waste, ranks very high among the environmental problems in industry outlined in section 2.2.

Besides technical measures, however, the interviewees frequently referred to the replacement of pollutant feedstocks and inputs with products less

harmful to the environment (e.g. cold cleaners instead of surfactants, water-based paints instead of paints based on solvents containing CHCs). The use of 1,1,1-trichloroethane as the solvent in place of trichloroethylene is hardly any less dangerous (see Moll 1987, p. 197), although the interviewee concerned did not consider it worth mentioning this or was unaware of the fact.

Substitution, which initially entails no more than a decision to use different substances, without the process being changed, often calls for new technology (e.g. a new type of plant where different solvents are used) or for the reclassification of intermediate and end products.

The technical approach tends to go with a rather passive, reactive strategy, the essential boost being provided by new information on technical options as well as changes in legislation (see below). Some firms can also be described as "activists" in the field of environmental technology. However, this "activism" cannot yet be equated with a systematic, integrated search for solutions to problems, the rarest type of action encountered in the sample.

The statements on the history of environmental protection in firms undoubtedly reveal a tendency to shift from the extreme of end-of-pipe/passive/reactive strategies in environmental protection towards integrated/active strategies, from curative to preventive strategies. Typical features of the broader view being taken of environmental protection are, for example, doing more than required by the regulations (U6M, U10C), taking account of environmental aspects outside production (e.g. in administration, in the canteen, in packaging; U4M, U1C, U8C, U10C) and institutionalized information and consciousness-raising measures (environmental protection conferences and annual reports [U8M]; newspapers and brochures produced by firms [U1C]; pilot training projects [U1C]). The change in the nature of environmental protection was ascribed by the telephone interviewee (U12C), for example, to the succession of different "generations" of corporate environmental policies (from disposal- through production- to product-oriented environmental protection; see also Bayer 1988).

This broader view is accompanied by steps towards "environment-oriented management" concepts (see, for example, Seidel/Menn 1989, Pfriem 1989), which are increasingly propagated by firms themselves (see Winter 1987 on the firm of the same name, which is endeavouring to make ecological thinking a feature in all its functional areas). Associations established specifically for the purpose bear witness to this trend.

Of the firms studied, those most likely to act as trail-blazers in environmental protection are under heavy pressure to be technologically innovative (U6M), have appropriate resources, being or forming part of large enterprises (U1C, U8M, U4M), or are simply disciples of the philosophy outlined above (U10C, a member of Förderkreis Umwelt - "future", a group that promotes environmental protection).

While it is a rarity for environmental protection to be seen as a strategic market factor (extending to the decision to withdraw environmentally unfriendly products from the market), the effect of external constraints is evident in several firms. Foremost among these constraints is environmental legislation, but structural restrictions of the freedom to conduct ecological experiments imposed by relations with customers and suppliers also play their part (quality prescribed by principal customers or refusal to impart information on the composition of inputs).

Despite all the criticism of the dominance of the technical approach to environmental protection in the firms studied, it should be emphasized in conclusion that the implementation of technical and disposal measures cannot be taken for granted under present conditions (legislation there may be, but enforcement is lax). That all the firms studied are relatively active in the field of curative environmental protection is probably largely due to their size and the generally advanced state of the art.

The organization of environmental protection

Like the general nature of environmental protection in firms, its organization depends on demands voiced by the public, legislation, features of individual firms and priorities of their commercial policies. The combination of these factors in each case thus determines how environmental protection is organized, with variations both in the amount spent and in qualitative specialization.

Units of firms responsible for environmental protection have emerged and multiplied primarily because of the statutory provisions on protection against immissions (Federal Clean Air Act), the prevention of water pollution (Water Resources Act) and the treatment of waste (Waste Disposal Act) and amendments to tighten up these provisions. They refer to tasks for the firm as a whole, and these then have to be translated organizationally into requirements to be met by various activities.

Specifically, the statutory provisions gave rise to the activities of employees responsible for protection against immissions (U1C, U7M, U8M, U9C, U10C), for the prevention of against pollution (U10) and for waste (U2M, U10C), usually known collectively as "environmental managers". Where the term "environmental manager" is used in the following, it is intended to mean all such employees required by law and a second group appointed voluntarily by the management of firms. Thus defined, environmental managers form the organizational heart and backbone of environmental protection in firms.

Of the 22 interviewees, eleven are environmental managers. (Various environmental managers are also referred to on several occasions in the interviews as examples of activities in the firm relevant to the environment). Their dominance in the sample is quite simply due to the fact that, as they are the environmental protection experts, there is no ignoring them. Only five were appointed for one or more aspects of envi-

ronmental protection because of statutory requirements. In some cases the firm itself has added to the responsibilities required by law (e.g. U1C, U10C). Comprehensive responsibility for environmental matters is also typical of all "voluntary" environmental managers.

Environmental managers differ not only as to the cause of their appointment and the scale of their responsibilities (or the resources and staff allocated to them) but also as to the nature of their posts. Four occupy (full-time) posts and are responsible only for matters relating to environmental protection. The other seven also perform other tasks. There is something of a link between the factor which led to the creation of the post and the features of the post inasmuch as all the "full-time" posts stemmed from a statutory obligation, whereas this is true of only a few of the "part-time" posts.

Viewed formally, all full-time environmental managers are also employed outside the "line system" of the normal departmental structure, i.e. in "staff units". All part-time environmental managers, on the other hand, occupy "line" posts (exception: U5C). Although the information available indicates that they are formally line employees, several part-time environmental managers see themselves as occupying staff posts - probably because the functions they perform have an impact outside their own department.

The example of the environmental manager shows that environmental protection, being a new area of activity, is either leading to new posts or being assigned to existing posts as an additional task. These two basic organizational forms are also to be found in functions other than those performed by the specific group of environmental managers (for further details see below). Their emergence and the differences between them are due not least to the growing complexity of technical equipment and the resulting increase in the complexity of tasks.

The two basic forms outlined above are not necessarily alternatives: in some cases they complement each other (e.g. U4, U9C, U10C). This gives rise to communication relationships "at right angles" to the organizational structure. An example is the environmental manager who cooperates directly with the production worker responsible for disposal (U4M).

Where his "opposite number" occupies a senior position, this situation may have the advantage for an environmental manager (with overall responsibility) in a staff position of facilitating his "lateral entry" into the hierarchy and making it easier for him to persuade his subordinates of the importance of the environment (U10C). In more general terms, work relationships arising from horizontal links resemble those of a matrix organization. The employee responsible for environmental protection falls back on one or more functional areas of the firm to be able to perform the tasks assigned to him.

More typical, however, appears to be the situation in which the post is part-time (U2M, U3M, U5C). In such cases formal organizational lines run

from the environmental manager (at middle level) to subordinate employees at the lowest level (U5C, U6M, U8M).

In contrast, most of the posts in firm U1C are full-time. A considerable number are combined in separate (staff) departments. The central environmental protection department (with over ten posts) responsible for the whole group of companies reports directly to the management board. Below the central department is a further staff department (with over 20 employees) headed by the environmental manager designate responsible for protection against immissions, this being the environmental protection department for Berlin and all the group's firms there. Other locations where there is only one plant have staff posts occupied by environmental managers who are accountable to the plant manager. Firm U12C also has departments for specific aspects of environmental protection ("specialist departments"). As where posts are part-time, a clear-cut structure of posts (manager, advisers, specialists) can be identified within staff departments (U1C, U10C, U12C).

A structure of this kind, with several levels and/or departments, undoubtedly exists only in very large enterprises where a great deal needs to be done in the environmental field (e.g. U4M, part of a conglomerate). However, the trail-blazer, U10C, has also set up a small staff department. A glance at several levels reveals a further distinguishing feature of environmental managers, their level in the organizational hierarchy.

Relatively independent of the formal structure of environmental protection, a "dual" situation can be seen in several cases, with one post primarily taking responsibility for and developing environmental protection processes and the other primarily implementing these processes (U2M, U4M, U5C, U6M).

Besides the statutory norms and the dictates of commercial policy which require the establishment of an official post for environmental protection, the interviews reveal a third "cause" of the institutionalization of environmental protection: the personal initiative of committed individuals in the firm. For example, one works council member made environmental protection in his firm a topical issue, with the result that the management set up a provisionally informal Working Party on Waste consisting of three employees from different parts of the firm (U11M, similarly U2M). In another case, a separate post was even created following an unrelated application from outside (U1C).

The abovementioned working party is also significant in that it invites the assumption that a collective form of organization champions the cause of environmental protection. This assumption is confirmed by similar cases, e.g. the Working Party on Surface Treatment at U2M, the meetings of production managers at U6M and the Working Party on Motivation and Training at U1C. Reference should also be made to a firm not included in the sample, Henkel, where working groups attended by experts from the design, manufacturing and distribution departments have been set

up to coordinate aspects of environmental protection relating to the adhesives the firm produces (interview with LONGOLIUS).

Where environmental protection tasks are assigned to existing functions, it is particularly noticeable that in over half of the cases they are associated with or have even gradually emerged from responsibility for industrial safety (U2M, U3M, U4M, U5M, U9C, U10C). Industrial safety, which has a far longer history than environmental protection and is similarly governed by legislation, obviously provides many substantive points of contact for environmental issues (e.g. dangerous substances). It also prompts thinking on the direction in which environmental protection might develop institutionally (system of safety managers, trade cooperative associations).

Nor indeed should it be forgotten in any reflections on the organization of environmental protection that it is a process. A snapshot can easily conceal the fact that organization means organizing, that a great deal is fluid in this respect. This is fully endorsed by the interviewees' comments on the history of environmental protection.

An initial typology of task profiles

A rough description of the organization of environmental protection in firms already reveals faint outlines of different functions. There is thus a major difference between a post specifically created or completely redefined to cater for environmental protection and the assignment of environmental protection responsibilities to an existing post involving functions having their origin within the firm. Although the firm's general and fundamental interest in profit is not disputed, the immediate purpose of the post obviously differs. In the first case, environmental protection is the sole purpose, which also means that the post would not exist if there were no such thing as environmental protection ("function type I"). In the second, environmental protection forms part of a "multi-purpose function" ("function type II").

Leaving aside the difference between them, what the two types of function have in common is that environmental protection is a separate, definable task for them; environmental managers make this particularly clear. Yet activities to protect the environment may also be undertaken elsewhere. Such activities relate to functions in which environmental protection loses its independence and to some extent merges with the other activities undertaken. The environmental protection task then consists in performing existing tasks as required, in modifying and supplementing them to cater for environmental protection or even in rejecting and redefining them.

The difference between environmental protection as a separate task and environmental protection as one of several tasks is diametrically opposed to the difference in the case of the immediate purpose for which the post is created. It is thus possible to form a four-field matrix permitting an initial typology of requirement profiles in environmental protection.

It covers all activities of which environmental protection is becoming or has become part and draws relatively sharp lines between them. Figure 1 shows the structure of the matrix and gives two typical examples in each field.

Figure 1: Function types in environmental protection

		Post devoted solely to environmental protection	
		YES	NO
Separate tasks relating specifically to the environment (definable)	YES	IA Environmental manager in staff post responsible for protection against immissions Scientific adviser for continuing training in environmental protection (Water supply and sewage disposal technician)	IIA Part-time voluntary environmental manager Skilled production worker with additional disposal duties
	NO	IB Chemical laboratory assistant in the environmental department Member of PR department responsible for environmental protection	IIB Waste water treatment operative Engineer in development designing systems suitable for recycling

The representatives of function type IIA come from different functional areas in the firm. Members of the sub-group of part-time environmental managers occupy posts which more often than not are organizationally linked to the technical service department (with "its services for production") or are assigned directly to production. An industrial clerk

from purchasing who has been appointed environmental manager for waste is the exception (U9M). This seems highly appropriate in terms of preventive environmental protection.

Another example of type IIA functions is the skilled production worker who takes care of waste disposal in his own and other departments "on the side" (4b). However, this task can also be performed by the assistant to the head of the laboratory (5b) or by the caretaker (U6M). Furthermore, the list could be extended to include all employees whose expert knowledge tends to be called upon irregularly to seldom to deal with environmental protection issues that suddenly arise. An apt example is the process engineer working in research and development who is entrusted with the special task of developing a new ecological process (U1C) or the chemical engineer in the technical service department who is required to assess the compatibility of a new material (U6M).

Finally, reference should also be made to the case of the works council member responsible for environmental protection (U10C). If a representative of the workers' interests is politically committed, the environmental protection activities he undertakes may extend well beyond his firm, as the activities of the works council at Meyer-Werft in Papenburg show.

To summarize, it can be said that type IIA functions are chiefly performed in production itself and in the immediately adjacent technical and scientific "service areas".

Function type IIB covers relatively the widest range of activities. The more aggressive a firm's environmental protection activities, the more activities this function type includes - in the most favourable of circumstances, the activities of all the employees. Where specific references are concerned, the interviewees gave surprisingly few examples at production level. It seems that the general scope for action in this area, combined with the use of only small quantities of problematical substances, tends to reduce the relevance of activities to the environment.

This finding may be due to the selective nature of the sample: when considering the chemical industry, for example, experts (e.g. PAUL) constantly describe the typical area of activity of skilled chemical workers as being particularly relevant to the environment because of the large quantities they handle. Although firm U5C also refers to type IIB production workers who prepare mixtures of substances in considerable volumes, relevance to the environment in this case is restricted to the excess waste occurring when substances are mixed incorrectly. The ecological costs (of waste) closely match the economic costs.

Other examples are plant operatives (recording faults, ensuring values are observed, adding and withdrawing process materials; U1C, U4M, U8M, U9C, U10C), operators of production machines in metal-processing (punctual replacement of drilling emulsions, for example; U4M) and electroplaters who change baths or ensure the rinsing water is clean (U4M, U9C). In this context reference should also be made to the water supply and

waste disposal technician interviewed, who is responsible for a large waste water treatment unit (without having had any training in this field) (6b).

At the level of superiors in function type IIB the most frequent references are to foremen. Some are integrated into the disposal communication network (U2M, U3M, U9C), but in addition to this they often have some influence on attitudes towards environmental protection in that they are required to give instruction and to structure jobs with ecological interests in mind. For the head of the environmental protection department (U1C) the managers of chemical production plants and the operating assistants assigned to them represent the archetype of a IIB function profile.

The reference in the planning sphere to an employee in central investment planning (U1C), a factory planning engineer (U2M), a specialist in production scheduling (U2M) and a plant engineer (U1C) who is planning a plant that requires official authorization shows that in some cases environmental protection is also seen as an inherent, preventive requirement.

Production aside, most references are to research and development (assessment by chemists and chemical laboratory assistants in the analysis department pursuant to the Chemical Substances Act) and to the technical service department or plant maintenance. It seems that selective intervention in the production process (retooling of machines by tool-makers, maintenance and repair by mechanics, maintenance and work scheduling with prescriptions for environmentally compatible tool manufacture) is often far more relevant to the environment than routine production activities per se.

Rather unusual is the reference to fork-lift and lorry drivers who transport hazardous goods (accident-free and low-risk driving; U3M, U1C) or to salesmen (consideration of environmental interests in marketing; U10C).

So much for an initial description of requirement profiles in environmental protection and their place in various functional areas of firms. While the four-field matrix enables posts to be classified and statements to be made on trends in the quantitative distribution of functions, it does not tell us a great deal about the specific, substantive form of functions. Hence the more differentiated and selective view taken in the next section.

3.2.2 More differentiated description of tasks

Task configurations in environmental protection - some examples

The qualitative features of tasks in environmental protection will first be illustrated by reference to a number of specific functions or incumbents (who/which do not stand for others), before the second step of classifying them on the basis of overriding criteria is taken.

Of the type IA functions, that of the environmental manager at U10C attracts particular interest. He is responsible for environmental protection throughout the firm. On the one hand, he must ensure that a wide range of legal standards are observed (prevention of air and water pollution; waste; faults; hazardous goods; coordination of industrial safety experts); this includes, for example, the completion of authorization procedures involving contacts with the appropriate authorities, the classification of substances and products by degrees of danger or types of waste, arranging for measurements to be made, some being carried out externally, and determining organizationally who is responsible for the practical implementation of certain measures.

On the other hand, he is required by management to make environmental protection the overriding idea - over and above any legal norms - in as many of the firm's functional areas as possible (from investment planning and the purchase of equipment to the sale of end products). In this context he is responsible not only for developing appropriate concepts but also for the "environmental counselling" of the workforce and for frequent communication with as many of its members as possible to promote awareness of the environment. In all, his tasks embrace planning, implementation and monitoring. The chances of these tasks being performed are good: although a staff post, it is endowed with a certain amount of authority in that the interviewee has a right of veto and the managing director himself is called in when disputes arise.

While the function described above has generalist traits, function type IA also includes specialized functions. This becomes clear from the answers given by the scientific adviser (1b) in the central environmental protection staff department. Her activities centre on "imparting" the attitudinal goal of environmental protection; she also has the task, however, of carrying out preliminary work for the ecological assessment of production sectors, products, processes, etc. (eco-assessment). In imparting the environmental goal, she not only advises on training, looks after a working party on the improvement of the environment and heads the "motivation and training" working group but above all plans, arranges, runs and evaluates further training seminars on general environmental subjects for various target groups. The seminars are geared at least as much to perception, consciousness-raising and the recognition of options as to information relating specifically to environmental protection.

As the instructions issued by the adviser's superior, who is directly accountable to the management board, are kept to a minimum, she enjoys unusually wide scope in the organization of her activities. Although she has no authority to issue instructions herself and is not required to ensure action is taken "on site", by comparison with staff functions at department level her post gives her quite considerable opportunities to exercise influence since her fellow working group members are themselves the heads of the various departments.

The only, but probably outstanding, example of function type IB is the chemical laboratory assistant (10b) who reports to the environmental manager described above. Her tasks consist in recording harmful sub-

stances in inputs (questioning suppliers), carrying out water analyses at the purification unit and drawing up computerized safety data sheets on finished products, which subsequently serve as the basis for product-related environmental advice given by the marketing department (classification in poison categories; indication of safety measures to be taken; instructions regarding toxicology, storage, disposal). Her tasks thus include implementation and monitoring. The freedom she enjoys in implementation consists in the lengths to which she is able to go in determining potential ecological damage.

As an example of the representatives of function type IIA, whose function is heavily geared to planning and conception, let us take the environmental manager at U6M. He is the deputy head of the technical service department. Although not required by law, external communication with authorities (concerning in particular prior agreement on plants requiring authorization) is one of his core tasks. He also ensures that appropriate account is taken of environmental protection in investment planning and the servicing and maintenance of equipment at least up to the level required by the law, and in this respect his position as a superior helps him at shop floor level. He also defines the tasks of an electroplater who is his subordinate and responsible for water supply and waste disposal at the waste water treatment unit (6b). The environmental manager is similarly responsible for drawing up instructions, arranging meetings of production managers for the discussion of environmental issues and generally motivating the workforce to protect the environment.

While these tasks are largely representative of type IIA environmental managers, the environmental manager at U7M is an interesting special case. Although he, like several others, is assigned to a "service department" (maintenance, planning), he is responsible for both the development and the implementation of organizational procedures relating to environmental protection; this may be due to his "middle-ranking status" as a trained technician. The configuration of tasks in this case is thus extremely varied. It ranges from the preparation of authorization documentation and the monitoring of limit values through the processing of disposal forms and communication with disposal firms to physically helping to collect wastes.

On the other hand, there are several type IIA functions in which implementation dominates, an example being a fitter (5b) who can be described as the "right hand" and, in practice, the "extension" of the environmental manager (to whom, as a laboratory employee, he is also directly accountable). His tasks, in which industrial safety and environmental protection are closely linked, consist in disposing of special waste (examining containers and their contents, attending to the dispatch note procedure, making waste ready for dispatch), ordering and issuing aids and equipment (protective masks) and taking samples. In addition, he enjoys relative freedom in the selection of disposal firms, he is a member of the industrial safety committee, and, in his own words, he "sells environmental protection" to his colleagues by always acting in exemplary fashion and by using his persuasive powers. His work thus includes many aspects that go well beyond the requirements of his job.

To conclude, reference will be made to an electroplater (9b) who works as the overseer of a waste water treatment unit in the anodizing section and is representative of function type IIB. He is responsible for taking samples and making measurements, purchasing waste water treatment substances, neutralizing and detoxifying the waste water, operating the desalination unit, disposing of the sludge (together with an assistant subordinate to him) and ensuring (maintenance) that the unit is working "properly". He has also agreed to be on standby for emergencies. In performing his tasks, he has in some cases to cooperate with the laboratory (observance of the various prescribed water values), to coordinate his activities each day with the shift leader, shift foreman and production manager (with respect to production volumes and the quantity and "quality" of waste water) and to coordinate his activities with the environmental manager responsible for waste (disposal).

General view

These seven examples are sufficient to describe sets of tasks in certain functions. It is now clear that requirement profiles differ significantly depending on whether the tasks consist primarily in making arrangements, planning, doing the actual work or monitoring, on how much freedom of action there is in the performance of tasks and on the body which defines the tasks.

By comparison, the substances and aspects of the environment to which the tasks relate seem to be of secondary importance. It is appropriate, however, to try to determine and differentiate the content of tasks. A pilot study should, after all, reveal in particular what work environmental protection in firms entails. Environmental protection should therefore be regarded as a "job" which has to be done in addition to, in conjunction with or despite the economic process.

Subject to this proviso, environmental protection tasks can be classified by their contribution to the overall task. The result is a "phase model" for ensuring that the environment is protected. The model covers, literally or in generalized form, all the tasks referred to by the interviewees, but it has also been extended to include a number of important tasks on which no relevant incumbents were interviewed so as to give an ideal type. At the present stage of research it is not claimed that the model covers absolutely every aspect or that the dividing lines are accurate. It may well be that the phases overlap in practice.

Figure 2: Tasks in environmental protection - a process model

Phase	Substantive nature of the task: scope for creative action		Function type			
	Limited	Extensive	IA	IB	IIA	IIB
Problem identification:						
Measurements, arranging tests		x	x		x	
Measurements, making tests	x	x		x	x	x
Sampling	x			x	x	x
Preliminary work for eco-assessment		x	x			
Eco-controlling		x	x			
Identification and classification of substances		x	x	x	x	x
Assessment of problems/classification by standards:						
Interpretation of test results		x	x	x	x	x
Legal examination (identification, legal relevance, application of legal norms)		x	x		x	
Preparation of proposed solutions		x	x		x	x
Preparation of general standards and guidelines		x	x		x	
Preparation of problem-solving:						
1. Involvement of external information resources, incl. coordination of action						
Authorities		x	x		x	
Analytical laboratories	x	x	x		x	
Experts		x				
Disposal firms	x	x	x		x	x
Contacts with suppliers		x	x	x	x	

	Limited	Extensive	IA	IB	IIA	IIB
2. Maximization of internal communication and acceptance						
a) Organization/coordination						
Drafting specific instructions		x	x		x	
Developing processes		x	x		x	
Chairing relevant meetings, working groups		x	x		x	
Attending meetings	x				x	x
Attempting to integrate environmental protection into various of the firm's functional areas		x	x			
Maintaining contacts	x	x	x		x	x
b) "Imparting"						
Advising (production workers)		x	x		x	x
Training	x	x		x		
Involvement in training		x	x		x	
Discussion	x	x	x	x	x	x
Presentation		x	x		x	
Persuading		x	x		x	
Motivation		x	x		x	
Achievement of environmental protection objectives:						
1. with changes to the technical and organizational infrastructure						
Procurement of other materials		x	x		x	
Innovation - end products		x				
Innovation - technical processes		x			x	
Innovation - organization		x	x		x	
2. without changes to the technical and organizational infrastructure						
a) (Routine) handling of dangerous substances (outside units):						
Separation	x				x	
Collection of separate substances	x				x	
Storage	x				x	x
Disposal	x				x	
Waste prevention	x					x

	Limited	Extensive	IA	IB	IIA	IIB
b) Administrative supervision of dangerous substances:						
Dispatch note procedure	x				x	
c) Handling machines, equipment and work pieces:						
Consumption of materials, minimizing wear	x					x
Conserving energy	x					
Recycling	x					
Watching out for faults	x				x	x
d) Operating "environmental protection facilities":	x					x
e) Action in emergencies, when faults occur:	x	x	x		x	
Monitoring:						
Monitoring machines and equipment	x				x	x
Observance of legal, technical standards	x	x	x	x	x	x
Observance of behavioural standards		x	x		x	
Monitoring processes		x	x		x	

The model (see Figure 2) thus consists of five phases, which can be defined as "problem identification", "assessment of problems/classification by standards", "preparation of problem-solving", "achievement of environmental protection objectives" and "monitoring". The breakdowns within the various phases are not meant primarily as time sequences. Where the implementation of environmental protection measures is concerned, a distinction has been made between actions and measures undertaken within the given technical and organizational infrastructure ("conservative" approach) and those which tend to change the organizational and production apparatus and are usually seen as reflecting an "innovative" and preventive approach to problem-solving.

The decisive conclusion to be drawn from this substantive evaluation is that internal communication for environmental protection purposes is extremely important in the area both of organization and coordination and of imparting information. Its importance is indicated by the number of different references to tasks in this context and above all the frequency with which the various references occurred. The tendency already emerging in the examples can thus be confirmed for the whole sample.

How are these tasks distributed? Where the functional areas in firms are concerned, the following general structure emerges. "Conservative" environmental protection appears to concern primarily production, maintenance and storage (whereas transport and administration, for example, are rarely mentioned in the context of ecological management). Any "innovative" measures taken originate in particular in technical services, design and research and development. As a rule, the preliminary work on problem-solving and monitoring are also removed from the production process as such and assigned to staff units or even the technical service department.

Beyond this breakdown, however, there is often found to be no strict "division of labour" in the performance of the tasks. Although environmental managers typically take overall responsibility, the performance of their tasks is highly executive in nature (compared with what the law and management prescribe). Precisely because they are frequently assigned to staff posts, functions in which directions are given and which are equipped with authority to match are kept within close limits. Thus where the arrangement of environmental protection measures primarily means implementation, scope for creative action during implementation becomes a decisive criterion by which the tasks can be distinguished. Figure 2 demonstrates, however, that in environmental protection very many tasks go beyond the mere carrying out of instructions without any alternative and that they are highly variable and often highly complex. In any phase environmental protection frequently means uncertainty, ambiguity, contradiction, searching and flexible adjustment. Here again, then, there is no clear-cut division of labour.

In particular, there is little that is hard and fast about the performance of the tasks leading up to actual implementation. One exception is perhaps the taking of samples. Some tasks, like measuring and external communication, may be both complex/variable and simple. In the implemen-

tation of environmental protection measures "conservative" actions tend to entail adjustment to instructions, while "innovative" actions leave considerable room for manoeuvre.

In addition, Figure 2 not only reveals the distribution of references to tasks (without frequencies) among the types of function: it can also be read "in combination" in the sense that function type and scope for creative action indicate sets of conditions governing the incidence of the various tasks. It is apparent that the differing organizational assignment of environmental protection as a separate set of tasks does not entail a clear trend towards a division of labour. Many tasks arise for type IA and IIA employees alike where they are of a more complex nature. In the case of preliminary work on problem-solving, however, the latter refer more frequently to organization and communication tasks, which is probably due in part to their place in the hierarchy. On the other hand, some of the representatives of function type IA happen to be "specialists" who have been relieved of organizational duties and are often able to concentrate on matters that go beyond what is strictly required.

In the "conservative" implementation of environmental protection measures, however, representatives of function type IIA with more simply structured tasks clearly dominate. In this case, then, they differ from type IA employees.

As regards the division of labour a comparison of A and B functions reveals that the latter play little or no part in the assessment of problems or the preparation of problem-solving. This difference indicates how important it is for the special task of environmental protection to become firmly rooted in the firm as an area of activity (before it comes to implementation). This cannot be emphasized enough. Given the quantity of data available, however, the value of the observations in the case of function types IB and IIB should not be overrated. The tasks of the only representatives of function type IB interviewed are largely confined to problem identification and external communication. The picture emerging of the tasks performed by the representatives of function type IIB is mainly due to the fact that the interviewees have very little freedom when implementing measures. Presumably ecologically oriented development engineers, buyers, material testers and distribution experts could also cope with some parts of the spectrum of innovative problem-solving.

3.2.3 Personal requirements for the performance of tasks

Required competences

According to the CEDEFOP terminology, competences comprise "qualifications", "social requirements and attitudes" and "competences in the narrower sense". Competences thus interpreted and to be specified for environmental protection contrast, as subjective aptitudes, with the objective requirements in this respect and are essential if they are to be met. Although the competences described as necessary by the inter-

viewees may be the rule, it cannot be taken for granted that they actually exist. The interviewees admitted explicitly to only a few shortcomings in their competences. Irrespective of some lack of distinction between the ideal and reality, interest here focuses on the nature of competences. The main conclusion to be drawn is that the performance of environmental protection tasks depends neither exclusively nor primarily on professional qualifications. In some functions, which were not, however, investigated with the help of interviews, they obviously play no part at all.

Let us begin with "qualifications" in the sense of knowledge, with a basic distinction made between expertise relevant to the environment and a kind of general ecological education. As most interviewees see it, the nucleus of expertise is formed by the vocational qualification, i.e. the skills learnt during training and subsequent practical experience. It is significant in three respects. Firstly, it not only equates with an (occupation-specific) aspect of the basic knowledge needed for environmental protection in firms (e.g. scientific, engineering or electroplating know-how), but - against the background of practical experience - also includes a wide knowledge of the "feasibility" of certain options. Secondly, according to several interviewees, it is the most important prerequisite for the assimilation and application of knowledge relating specifically to the environment. Thirdly, as an assurance or at least a sign of authority, it gives interviewees with intricately structured activities support in their efforts to protect the environment. It is important for both "normal" employees and superiors to "hear the convincing voice of the expert".

This qualification nucleus is sometimes surrounded by the second "objective" component of relevant knowledge acquired in other training courses (e.g. chemistry for the engineer or electroplater). A third element of expert knowledge is the familiarity with internal procedures and generally with the procurement of information that comes with a wealth of experience. The fourth factor is knowledge relating specifically to the environment, with knowledge of environmental law and environmental technology in greatest demand.

Environmental protection thus often requires a wide and complex range of expert and specialized knowledge. Among the interviewees we find, for example, combinations of "engineering, chemistry and law" (4a, literally), of data processing, or working with databases, and engineering (2b), of technology and familiarity with the market (3a) and of economics, education and ecology (1b).

While such combinations exceed the technical requirements of environmental protection, some interviewees refer explicitly to the "interdisciplinary thinking" that is much discussed in the ecological context, even though they do not necessarily associate this with the ambitious claim systematically to comprehend the complex interrelationship among areas of knowledge. The interviewee who probably comes closest to being able to make this claim is the environmental manager at U10C, who can offer not only scientific, technological and legal know-how but also knowledge of

administration and, in addition to this, emphasizes the need for "anticipatory thinking".

Comprehensive thinking overlaps general ecological education, the second area of "qualification" (knowledge of global environmental problems, ecological correlations and principles, causes of the destruction of the environment etc.). The presence of such elements of education, let alone their involvement in working practice, can be detected in only a few of the interviewees (1a, 1b, 2a, 2b). Conversely, pronounced "thoughtlessness" is noticeable in other interviewees, despite clear links between their own activities and major environmental problems.

As a whole, the qualification profile that has been outlined tends to be an ideal type. No one person combines all the elements. However, "multiple combinations" are common. This is particularly true of representatives of function types IA and IIA with complex tasks, the latter having to be perhaps even more versatile since their solutions need to pass the direct practical, economic test. People in type IA functions, on the other hand, tend to "specialize" in more general education and also more detailed knowledge. Those in type IIA functions as a "practical extension" get by with their vocational qualification and knowledge of the firm. In the case of the type IIB interviewees (at the lower end of the hierarchy), however, a wider technical knowledge certainly appears to play a part, examples being a knowledge of basic chemistry and of the effects of damage (9b) and a knowledge of limit values and the link between the concentration of pollutants in waste water and waste water levies (8b).

To judge from the frequency with which certain competences are mentioned by the interviewees, "social requirements and attitudes" rank higher than vocational qualifications. Here again, various components can be discerned, the boundaries being fluid. Specific reference is made to competence to take action, the ability to motivate and values. Competence to take action means the ability to draw attention to environmental protection and to make progress in this sphere, and to do so in situations where it is not enough just to be an authority on the subject.

One aspect of competence to take action is assertiveness. Although it is not explicitly mentioned, it is covered by the references, for example, to a talent for organization, rhetoric, the ability to reason, techniques for obtaining information, presentation and negotiation. Competence to take action also entails a social skill, variously described as the ability to work as part of a team, loyalty to one's colleagues, cooperativeness, sociability and communicative competence.

This cooperation/solidarity dimension of competence to take action leads on to the ability to motivate others to act in the interests of the environment. The fact that the motivation task and "persuasion" (explicitly mentioned twelve times) are singled out by the interviewees with the greatest emotional emphasis could be interpreted as meaning that these competences are also subject to constraints. To describe what is specifically required and is brought into play in some cases, they use the

terms education, psychology, empathy, understanding and competence to advise.

Persuasiveness is in turn closely related to personal credibility (ideally, "setting an example"), which is based on certain values that rate environmental protection high. This link is also forged by some of the interviewees (1a, 1b, 2a, 2b, 8a, 9a). At the same time, it is noticeable that several argue against excessive emphasis being placed on such normative guides. This fits in with the reference, depending on the individual's viewpoint, to "greens", "green eccentrics" or "green crackpots", who stand little chance. Another factor which promotes environmental protection is personal commitment, i.e., in effect, personal motivation. In conjunction with an authoritative knowledge of the subject, the interviewees consider this to be particularly important where the aim is to persuade superiors of the wisdom of certain decisions relating to environmental protection.

Finally, mention must be made of a third complex of values which indicate the degree of "social integration" in the firm. They consist, firstly, of loyalty and responsibility and, secondly, of such "secondary virtues" as reliability, sense of duty, care, orderliness and helpfulness.

Reference to secondary virtues is typical of people who "second" an environmental manager in a type IIA function. The considerable importance which some interviewees and people mentioned by them attach to such virtues is evident from several interviews. Thus a "nose" for inherently dangerous situations, a "rescue service mentality" (rescue diver, first-aid man, safety officer and future environmental protection watchdog in one person), an eye for dirt and the qualities of a caretaker may thus make a major contribution to ensuring the protection of the environment.

Of the "social requirements and attitudes", persuasiveness appears to carry most weight. In some cases, this is even true of the "seconds" of the IIA type - obviously because functions enriched with communication tasks make this skill essential. This conforms to the opinion expressed by several environmental managers that acting in the interests of the environment is often not a question of technical qualifications in the case of executive activities of the IIB type but of motivation and attitude. In a comparison of type IIA and IA functions, these socio-cultural competences are probably more useful to the latter because they are more likely to entail direct, daily contact with the workers who have to be convinced.

On the whole, the third type of competence, "competences in the narrower sense" (primarily practical abilities and skills), must be regarded as of less than secondary importance for the achievement of environmental protection objectives. Hardly any of the interviewees mentioned them without prompting. They are most likely to be helpful when it comes to carrying out makeshift repairs on defective or incomplete equipment (IIA: 4b, 2b, IIB: 6b).

Relationship between vocational training and careers

What is the relationship between the competences considered necessary by the interviewees and their own vocational training? In what kind of training are the competences for environmental protection acquired? In answering this question, which takes us back to the supply side, a distinction is appropriately made between the level and nature of the qualification acquired. Where the formal level of training is concerned, almost all the type IA and IIA type functions involving complex planning and conception tasks are performed by graduates in the firms considered. The exceptions are the abovementioned technician (S...) and a foreman, who work as part-time environmental managers, although the latter is rather considered to have been shunted aside. In contrast, people who have been trained by the dual system for an industrial, technical or craft occupation work in positions which promote the partly physical, partly communicative/organizational "extension" of conceived environmental protection (4b, 5b).

A comparison of type IA and IIA functions, both performed by graduates, shows that the latter are more often performed by engineers, whereas scientists (and other university graduates) dominate in the former. This finding may be due to the nature of the sample. A systematic link is, however, indicated by the fact that the practical/technical side, preferably joined by thinking in cost terms, is very important in type IIA posts. Engineers are generally expected to be well equipped in this respect.

The crucial point with regard to the nature of qualifications is the surprisingly little importance attached to environmental protection as a subject for training at any level. In initial training it has yet to play any part at all in 17 of 18 cases. Only the (fairly young) electroplater who works as the water supply and waste disposal technician in the special electroplating firm (6b) reports that the dangers of the production process were occasionally discussed at some length during his apprenticeship in a small firm. One cause of this shortcoming is undoubtedly the gap between the average age of the interviewees and the topicality of environmental protection as a requirement in working life: all of them in effect completed their training before environmental protection became a training subject (always assuming it has become one in the meantime). It still has to be explained, however, why the environmental protection posts in the firms studied are not occupied by people who have had relevant training in environmental protection.

This almost complete absence of qualifications in environmental protection is also true of continuing training when it comes to additional qualifications of any demonstrable substance. Only the interviewee who has been retrained as a water supply and waste disposal technician (8b), to some extent the scientific adviser (1b; because of her doctoral thesis on an ecological subject) and the engineer at U8M (8a; because he acquired the "expertise" for the post of environmental manager responsible for protection against immissions) have obtained qualifications in environmental protection backed by an "official" certificate.

The situation is different in the case of on-the-job further training, which does not lead to any formal change of status. All the interviewees undergo such training. Three variants can be distinguished. The first is literally informal and is provided "on the side", as it were, in the shape of information at the workplace (e.g. reading pertinent journals, laws or specific articles; "learning by doing"). The second takes the form of instruction in the firm and is naturally geared to people in what are primarily executive posts. The third variant consists of courses, the type most frequently mentioned being seminars at special continuing training institutions lasting one or two days, apparently the most common form of further training. However, there are also meetings for exchanges of experience and discussion groups arranged by industrial associations and, where groups of affiliated companies are involved, participation in events arranged for the whole corporation. The third variant is largely confined to those with higher qualifications.

On average only a few courses of further training are attended each year. The better qualified and those in full-time posts tend to go in for more frequent and more varied further training. An outstanding example is the intensity of the further training undertaken by the environmental manager at U10C, the trail-blazing firm (10a): he claims it accounts for 20 to 30% of his working hours. Much the same can be said of the continuing training adviser, who has undergone further training as a result of her former position as a lecturer on environmental protection in firms. The training activities of the safety foreman at U5C are also remarkable (5b). As a member of the works council, he attends relevant trade union working parties. He has also attended seminars arranged by the Society for Informing Works Councils on Environmental Protection in the Chemical Industry (see p. 16).

The external further training courses attended all form part of the now wide range of environment-oriented further training in the Federal Republic of Germany (see Nitschke 1989a). They are typically run by bodies which have close links with industry and/or are "old-established" (e.g. chambers of industry and trade, technical academies, trade cooperative associations). Almost all the courses concern science, environmental technology or environmental law.

In methodological and didactic terms the courses are conspicuous for their short duration and the dominance of cognitively oriented instruction (many lectures). The only exceptions are the working groups and meetings for exchanges of experience, where the participants have a chance to describe their own situation, to talk to representatives of authorities and to get to know each other better as time passes. Thus neither the content nor the form of the courses attended enables the participants to learn more about the tense relationship between the economic and ecological aspects of the problem. They also provide few opportunities for acquiring the qualifications that are essential if a firm's environmental policy is to be implemented - communicative skills being a case in point.

General ecological education clearly lacks a basis of any consequence, nor are any major steps being taken to create one. On the other hand, practical experience may to some extent compensate for the failure to participate in further training relating to social skills. By and large, many years of practical experience and many years in the service of the same firm - with practical experience at shop floor level - seem to be the crucial requirements for a post in the firm's environmental protection unit. This background is typical of the majority of the interviewees.

Some of the interviewees who epitomize function type IA have directly relevant practical experience in environmental protection. On the whole, it is likely to be considered less important, however, that experience is a substitute for intensive initial and further training relating explicitly to environmental protection (which is in any case usually true only of directly application-oriented know-how). Instead, these features tell the employer that in all likelihood the person concerned has such "aptitudes" as "realism" (commitment to objectives inherent in the system), loyalty and reliability.

In so sensitive an area as environmental protection these qualities have for the moment priority over a wide and profound knowledge of environmental protection. The information available indicates that this is particularly true of type IIA posts which involve planning. One reason for this is certainly the "need" in this respect, which is undoubtedly most urgent in this case. The fact that the people concerned were working for the firm before the post was created and were themselves involved in its definition is also likely to have a bearing. The non-technical requirements for environmental protection posts are, moreover, stricter at the lower hierarchical levels in cases where the incumbents gain an insight into explosive problem situations.

As regards the ability to take responsibility it should perhaps be emphasized that the two lower-level interviewees who particularly stress their ability in this respect (4b, 6b) acquired it over many years of working for small firms, where conditions forced them to learn to answer for a great deal, to develop an eye for the whole range of activities and to stand in for the managing director.

Finally, reference must be made to a further distinguishing feature of access to definable environmental protection posts: what led to the post being occupied? This aspect was addressed when the organization of environmental protection was discussed. While some interviewees had nothing to do with environmental protection until given the task (5a, 3a), others accepted this area of responsibility after being concerned with the subject for some time (1a, 4a). Some of the latter group initiated the creation of the post themselves (2a, 2b, 11, 1b).

3.2.4 "Objective" restrictions on the performance of tasks

The extent to which prescribed or self-imposed environmental protection tasks are actually performed is far from being simply a question of personal qualities. Unless general conditions are conducive, even the most competent are thwarted. As the survey did not focus on objective general conditions or constraints assumed to be objective, only a few, brief comments will be made here. They concern three restrictions: hierarchy, communication and time. It would be going too far to investigate the causes of these restrictions.

Position in the hierarchy

As almost all the interviewees take an optimistic view of the question of their freedom of action and the conflicts they have experienced, it would seem that they could achieve a great deal. At the same time, however, those who are heavily committed also tend to be critical. It must be assumed, therefore, that a positive view is largely due to a lack of ambition on the part of the interviewees concerned, which in turn is likely to be related to the dominance of reactive environmental protection.

Such observations aside, the position of environmental protection posts in the hierarchy undoubtedly has a major potential bearing on performance (see, however, the far from unequivocal findings of Theissen 1990, p. 247). One reason for the less than optimal performance of tasks is the inadequacy of the opportunities to bring influence to bear that "go with the post". From a purely organizational angle this is true of all staff posts whose incumbents have by definition less formal hierarchical authority than incumbents of line posts (no authority to issue instructions). This limits opportunities for tackling environmental matters in other areas. "Compensatory" means of exercising influence can be found, for example, in approaching the superiors of those who are to be persuaded to act in a given way. A distinction can be made here between direct superiors and the "common boss" (as in the case of 4a), who is usually a member of the plant management team or of the management board. In the former case, however, staff people whose posts are lower in the hierarchy than that of the person they approach are at a disadvantage.

Unlike their colleagues in staff posts, part-time environmental managers do not typically report directly to the management board or the first level (plant or works management) but occupy positions at the middle levels of the hierarchy in the line organization. They may issue instructions, but only to a limited extent. It is not uncommon for them to be at a formally lower level than those in whose functional area environmental issues have to be settled. However, a higher position in the hierarchy may also be a disadvantage in that economic objectives are more likely to clash with the aims of environmental protection at this level.

Employees involved in environmental protection differ not only in the opportunities afforded by and limits imposed on their respective "offi-

cial" posts but also in the degree to which they are granted rights of participation in the firm's decision-making by law or otherwise. The law provides for environmental protection officers to perform certain supervisory and monitoring functions (see Bornemann 1989, p. 68). Reference has already been made to the rights of works councils (and other groups of employees) to information and further training which are safeguarded by internal company agreements (see p. 16; for a discussion of the right to complain about dangerous substances see Schmidt 1989).

Another means of exercising influence is to make it compulsory for employees to attend internal courses on environmental protection (12). As already mentioned, the environmental manager at U10C also has the unusual right to put contentious issues before the managing director.

A brief mention should perhaps also be made of the potentially inhibiting effect of structural conflicts of interest. This situation arises when the operator of a plant is also responsible for matters relating to environmental protection (U8M).

The discussion so far has been confined to the various types of environmental managers and (other) staff posts because most of the interview data concern this aspect. Given the scant information available, statements will not be made on the occupational and qualification structures indirectly covered by the survey so as to avoid mere generalizations. As regards the activities at the lower hierarchical levels directly covered by the survey (IIA: 5b, 4b; IIB: 4b, 6b, 8b, 9b, 10c) it only remains to be said once again that, despite their formally low position, people at these levels enjoy considerable freedom of action. They do not, of course, have any influence on the strategic organization of environmental protection.

Communicative relationships

Communication structures in environmental protection were discussed above when the organization of environmental protection was described and examples of sets of tasks were given. These structures very much depend on the hierarchy.

In two respects in particular communicative relationships can, however, become a separate obstacle to or opportunity for the effective performance of tasks: communication with external bodies and informal internal communication. Environmental managers perform a "representative function" for the firm (see Rehbinder 1988, pp. 175 f.) when they liaise with supervisory authorities, disposal firms or consultancies. Referring to these bodies and to their dictates or directives or "threatening to go to the authorities" (1a) creates indirect opportunities for influencing behaviour.

Where informal communication is concerned, the interviewees give the impression that nothing like full advantage is taken of the opportunities it provides for cooperation with respect to environmental protection and

the firm's policy (to make the performance of tasks more effective). It seems reasonable to suggest in this context that a regular "network" of suitable people from various functional areas should be established so that their expert knowledge can be pooled. Leaving aside the possibility that certain employees are unable or unwilling to make informal contacts, such factors as departmental thinking, ossified communication structures and generally rigid corporate standards are likely to be primarily responsible for this deficiency.

Shortage of time

The implementation of environmental protection measures may also be deficient because there is simply not enough time for all the tasks to be performed. However, this problem concerns only type IIA employees, for whom environmental protection has to compete for time with the various other tasks they have to perform for the firm.

On the whole, the limited information provided by interviewees (environmental managers with one exception) on the time they devote to environmental protection does not reveal a great deal either. It ranges from a mere two to eight hours a week. The "peak value" is the 20% achieved by the two interviewees who have sought a new challenge in environmental protection on their own initiative and by making a routine of traditional tasks (2a, 2b).

The limited time allowed shows once again that environmental protection is an additional or subsidiary task which is often performed, or has to be performed, "on the side". Those who stand out for their high level of personal motivation in the field of environmental protection consider the time available to be far too short. These data indicate a time problem about which environmental managers frequently complain (see also Müller 1989, p. 73) and which tends to impede the effective performance of tasks. The majority are "part-time environmental managers" in line positions, the formal hierarchy being such that they have no or too few staff to carry out preliminary work for the overall range of environmental protection tasks (see Umweltmagazin 1989/2, p. 75; for the time problem and how it may be overcome by delegating employees see also Theissen 1990, p. 186). It is this impossible to eliminate the shortcomings in the performance of tasks unless less time is devoted to other tasks.

3.3 Résumé and tendencies

3.3.1 Occupational and qualification structures in the field of environmental protection: determinants, deficiencies and disparities

Despite some widening of the view taken of corporate environmental policies, environmental protection consisting primarily of curative, technical measures dominates at the firms covered by the survey. This type of environmental protection is often accompanied by a tendency for the interviewees to interpret the problems in a way that makes light of them

and leads to demands for permanent "plugging of the holes" (although perfection is considered an impossibility). What measures the firms take largely depends on the directly binding effect of environmental legislation (especially the Federal Clean Air Act 1974) and the indirect impact it has ("invitation" to institutionalize responsibilities through the voluntary appointment of environmental managers, for example). Besides the Industrial Safety Act, laws on environmental protection and, in the medium term, the training regulations and the provision they make for environmental protection, even arrangements between the two sides of industry will make environmental protection rather more compulsory in the longer term (for the two sides of industry see again Schmidt 1989). The limitation of many occupational and qualification structures in the field of environmental protection to the "narrow" confines of existing occupational structures is often due to the fact that firms are not yet pursuing an aggressive environmental policy.

The unusually strong movement revealed by our examination of occupational and qualification structures in this field does, however, indicate that they have the potential for structural change. This dynamism is heavily influenced by the change occurring in corporate environmental policies as a result of the broader view being taken. The development of occupational and qualification structures in this sphere is thus an extremely complex process. The mostly external impulses aside, environmental protection is typically a new field of activity, an area that is still open and needs to be explored, structured and dovetailed with the economic imperatives. The more comprehensive the view taken of environmental protection, the more difficult this dovetailing proves to be and the more varied the demands on (occupational) activities to ensure that it is achieved. Meeting these varied requirements tends in turn to call for so wide a range of "aptitudes" that occupational and qualification structures in the field of environmental protection not only consist of combinations of tasks and competences but also extend to the self-image of the people occupying the posts concerned.

This is clear from the emergence and constitution of occupational and qualification structure in the field of environmental protection: the legal provisions "from outside" and the decisions taken by management "from above" are joined by personal initiative "from below", the commitment of individuals, the third factor that encourages the creation of environmental protection posts.

The influence of the individual really becomes apparent when complex occupational and qualification structures emerge. Simply because environmental protection is a job that has to be done, it very much depends on individuals what they make of very general prescriptions. Viewing problems from many angles (e.g. recognition of the global dimensions of the destruction of the environment, refusal to trivialize the individual firm's contribution, awareness of economic and social factors), encountering and facing up to environmental problems outside the working sphere ("reference to life as a whole") and certain pronounced moral concepts (from "green" values through the ambition to solve problems with techni-

cal innovations to a "sense of order") are major subjective determinants of the emergence of complex tasks.

To the objective determinants must be added the stricter legal provisions now in force, growing technical requirements, the size of the firm as a rough indication of financial resources (for environmental protection) and the degree to which the firm is "exposed", the last of these determinants consisting of a combination of the size of the firm and the objective pressure of problems. Internally, the level of posts in the hierarchy, the "malleability" of the organizational structure and, generally, a non-rigid corporate philosophy also have a positive effect on the complexity of occupational and qualification structures in terms of both requirements and competences. The most exacting occupational and qualification structures emerge when an aggressive self-image of the promoters coincides with active openness "from above".

If the development of environmental protection as an occupational requirement is triggered primarily from within and if it can be called "progressive", an ideal type of model emerges and can be reproduced in the four-field matrix shown on p. 22. The model is composed of the two tendencies "enrichment and professionalization" and "differentiation and categorization". The first tendency stems from a situation where the activities which an occupation comprises conflict with ecological standards and are therefore modified to protect the environment (IIB). Above a certain level of coping with environmental issues responsibility begins to extend to other workplaces; this leads to the establishment of generalized terms of reference (IIA), which widen the existing range of tasks to include an "official" additional task. When the resulting, growing requirements make it increasingly impossible for the tasks to be performed properly in the time available, environmental protection has to be professionalized. This professionalization occurs first within the post, but eventually leads to the creation of separate (staff) environmental protection posts (IA). (Several firms envisage such full professionalization of IIA and IIB posts.) These posts may be increased in number and materially backed by support posts (IB). This process may have major repercussions for all type IIB activities.

The second tendency begins when the - generalistically oriented - incumbents of staff posts are similarly unable to cope with the variety of tasks. Where they do not themselves specialize, new specialist type IA functions are created and located at various "strategic points where they can exercise influence" (without, as a rule, being given the authority to issue instructions). The tendency to break down tasks down, which may also begin at an earlier stage, may also entail the creation of new type IIA functions (practical "preliminary work"). However, this should in no way be taken to mean that a rigid division of labour between complex and simple, repetitive activities typically occurs in environmental protection.

As regards the competences which can currently be observed, qualification structures conform fairly closely to the prevailing image of environmental protection: they are predominantly technical, and they have emerged

from the given conditions in the firm just as they are linked to them (for a critique and elaboration see Nitschke 1990). Sound, specific environmental protection competences of a specialist nature are a rarity, and this is even truer of general or non-specialist competences. The fact that the performance of environmental protection tasks often amounts to no more than "obedience", compliance with instructions that have been issued elsewhere, is usually due to a narrow view of these tasks. Even at the level of mere implementation, however, it would seem that the continuing effectiveness of regulations can be guaranteed only by such additional subjective elements as insight, motivation (in the sense of interest in the work and everyday endurance) and even a sense of responsibility. In average type IIB functions these attributes are, of course, given little systematic encouragement. The last mentioned competences play an even larger role in type IIA activities, even at a formally low level. (In representatives of type IA they are taken for granted and are not therefore decisive.)

The higher the formal level of qualification and the more professionalized the post, the sooner multiple specialist competences are needed, and they are rare among incumbents. Particularly in type IIA functions with authority to issue instructions they must, however, be combined with implementing competences. Seen as a whole, competences appear to become a "constraining factor" when a broad view is taken of environmental protection.

The shortcomings in qualifications that have been referred to can be illustrated to some extent in the categories of supply and demand and in the disparity between them. The most striking feature is the fact that with one exception, the man who was retrained to become a water supply and waste disposal technician, the sample includes none of the thousands of people who have meanwhile undergone one of the types of environmental training referred to in section 3.1. In relation to potential jobs they do not yet appear to be of any consequence. The "environmental occupations" in particular attract little interest in industry: people with traditional initial training and, ideally, many years of practical experience are in far greater demand. This view is also expressed elsewhere (interviews with PAUL and LONGOLIUS; for empirical data see also Sellin 1987). The supply of external training is not perceived or accepted, despite the evidence of shortcomings in knowledge relating specifically to environmental protection.

Tendencies for this gap to narrow are also emerging, however. With the growing professionalization and normalization of environmental protection, both the traditional specialized qualifications and the hitherto usual form of "normative selection" (selection based on such values as loyalty, reliability and conformity) are probably waning in significance. Some interviewees refer to a substantial increase in the attractiveness and an upgrading of type IB posts. This being the case, more of these posts may be advertised in the future. The example of the trail-blazing firms in environmental associations shows that the aggressive propagation of environmental protection may also result in the demand for skilled workers (IA) having an impact in the labour market (e.g. "skilled envi-

ronmental protection worker", "corporate environmental adviser"). The first few cases of this have occurred, though not at the firms studied (envisaged at U10C and U4M).

In the case of motivation, communication and persuasion in environmental protection, aspects considered extremely important in the survey, another gap is emerging: as (necessary) competences they are referred to far less often than tasks. This can be interpreted as meaning that the "official" image of the formal tasks does not yet take proper account of the real but, in some cases, "informal" tasks, the performance of which requires appropriate social competences. The real requirements are greater than those set out in the job description.

Against the background of the findings of the study of vocational training we can thus identify four levels of environmental protection competences. At the top is, as it were, the objective need, which is derived from a broad view of environmental protection. At the next level is the implicit or unacknowledged need, lagging behind which is the official need. Actual qualifications must be placed at the lowest level.

It may be due to the low level of the official need that a greater demand for relevant qualifications has yet to become apparent. Raising this level can in effect be equated with taking a broader view of environmental protection. This too may justify the assumption that vocational training in the field of environmental protection is likely to gain in importance.

3.3.2 Future occupational structures and qualifications

In the search for an answer to the question whether and where vocational requirements in the field of environmental protection will or are most likely to increase in the future the interviews have been useful in two respects. Firstly, they produced explicit information in reply to appropriate questions in the guide. Secondly, it can be assumed that there is some need to "catch up" in types of function where major shortcomings in competences are admitted or obvious.

A pronounced trend towards the full professionalization of activities involving environmental protection tasks cannot be detected at the firms covered by the survey. Greater emphasis is placed on further training in existing functions. When all the pertinent information is considered, the "future occupational and qualification structures in the field of environmental protection" can be assigned to given places where needs exist and described in terms of competence features (or level of need).

The former aspect concerns, as it were, the advance of environmental protection tasks into certain functional areas of firms, although more precise information on individual jobs cannot be given. The area most frequently mentioned is marketing: for one thing, it is directly affected by market processes, which either block or open up opportunities. Either the ecological design of products or production fails because the cus-

tomer does not need them or rejects them, or he insists on environmentally friendly products. The image of marketing as "product-related advice on the environment" is welcomed by several interviewees, especially in the chemical firms. For another thing, the environment idea is not yet firmly rooted in the minds of marketing employees in technical or non-material terms. The weakness of their qualifications is evident from the fact that in one case they are not alleviating reservations about environmentally friendly products and in another case they cannot satisfy their customers' need for sound and credible information.

One of the reasons why the interviewees concerned stress environmentally oriented advice on products is undoubtedly that they are themselves both buyers and sellers: to some extent they are themselves faced with the fact that inputs cause pollution. Accordingly, needs are addressed to the opposite side of the market. In the future purchasing, materials testing or industrial laboratories should therefore have more qualified people to make ecological quality assessments. This is particularly true of metal-working and small chemical firms that purchase inputs from large chemical plants (a view also expressed in the interview with KRAEMER).

Research and development can be approached from both sides of the market with requests for the information that is needed in each case. Regardless of this, however, R&D is mentioned several times in connection with increased occupational requirements in environmental protection. This must be seen against the background of shifts in the view taken of environmental protection towards preventive approaches, in which research plays an important part.

Finally, growing importance is being attached to waste as an area in which action needs to be taken. In one case this is generally ascribed to the growing difficulty of disposing of special waste. In another case reference is made to the function of the "recycling manager", whose task it is to propose ways in which customers can re-use or dispose of used products. This stems from the expectation that parts and products will be returned to the manufacturer in growing quantities as scrap or waste. As a result, a post of this kind has already been created in the firm concerned.

As regards the quality of the competences for which there will be a greater need in the field of environmental protection, the interviewees agree that current vocational qualifications are considered increasingly inadequate. It has already become clear that the appointment of environmental protection specialists will tend to be the exception. Nonetheless, the technical requirements are considered to be so severe in some cases that only university graduates can be trusted to meet them. The focus appears to be on further training relating specifically to the environment to improve existing qualifications (with the emphasis on knowledge of the law, technology and analysis). Perhaps the most important target group comprises foremen, with their opportunities to influence production methods. However, several references are also made to the improvement of competences to take in general ecological education

and the competence to take action. As these aspects have been described at some length in section 3.2.3, they will not be discussed further here.

More "holistic" occupational and qualification structures in the field of environmental protection thus seem to be in the offing, or at least the reservations about them are on the wane, while firms' interest in them is increasingly recognized. The way therefore seems to have been paved for appropriate efforts under the vocational training policy.

4. Outlook

If this study had been undertaken in the same firms two or three years ago, there would have been different and far fewer things to assess than there are today. This statement is a further indication of the recent emergence and rapid organizational change of environmental protection in firms. It can therefore be assumed that new occupational and qualification structures in the field of environmental protection will gain in importance not only in the public debate but also "on site". Precisely what training mandate this will produce for an organization like CEDEFOP cannot and will not be considered further here. Where research is concerned, however, it would be advisable, for example, to develop the types of functions and tasks presented here and to apply them to larger samples.

The advantage of the categories formed seems irrefutable. The four-field matrix, for instance, provides initial distinguishing criteria for an assessment of the relevance of activities to the environment and forges a link with the vocational training debate on the "integration principle" and "environmental occupations". It also enables the ideal type of development of occupational and qualification structures in the field of environmental protection to be illustrated. This makes it possible to assess the relevance of functions to the labour market. The phase model too helps to systematize environmental protection tasks and might permit more searching analyses in future evaluations.

Politically, it has become clear that training for environmental protection on a wide front is on the agenda. The competences to be taught will benefit not only environmental protection itself but also the general development of occupational qualifications and structures, like those considered to have a promising future under the heading of "key qualifications".

Even to enable existing standards to be met - especially in environmental law - there is a need for training. To take full account of the current priorities in firms, employees with many years of practical experience (primarily type IIA) would undergo a longer period of more broadly based training. This might take the form of educational leave granted specifically for training in environmental protection or of a sabbatical and should be geared primarily to the model of "multiple specialized competence founded on one basic discipline". In this context small and

medium-sized firms are of particular interest for a political strategy because they have the greatest need and the least financial scope.

Vocational training in environmental protection should not, however, be geared solely to adjustment to existing standards. More ambitious objectives would be the promotion of multiple environmental know-how even in initial training and the systematic development of interdisciplinary and networked thinking. As (semi-)professional subcultures emerge in environmental protection, greater importance should also be attached to the establishment of ecologically oriented professional ethics. There is, finally, a need for a form of vocational training in which the promotion of social skills is rated far higher than has been the case in the past and forms an integral part of specialized training.

Even employees who have been trained "holistically" for environmental protection in this way will, of course, be able to perform the tasks assigned to them only if appropriate general conditions prevail. In some respects influence can be brought to bear on these conditions from outside. This is the case, for example, where rights to information and to complain about environmental matters are enshrined in legislation or agreements between the two sides of industry. A right of veto for environmental managers is undoubtedly one of the most appropriate requirements in this context.

Thus vocational training policy will be the more effective in preserving the environment in which we live the more closely it is linked to approaches to the ecologically oriented promotion of the economy and preventive environmental policy or employee participation policy.

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Annex 1: Firms and interviews

Firm/plant	No.	Work-force	Sector/ products	Contacted through	Interviewee (No.)	Function type
Schering AG, Berlin	U1C	6,500	Chemical/pharmaceuticals, industrial chemicals, plant protection agents, etc.	IÖW Berlin, inquiry report	Head of environmental protection department (1a), scientific adviser on continuing training (1b)	IA IA
Orenstein & Koppel AG, Berlin plant	U2M	1,050	Metal/fork-lift trucks and excavators	Environmental protection working group at FGU, Berlin	Safety engineer and waste manager (2a), plant engineer and employee responsible in practice for waste and environmental protection (2b)	IIA IIA
Krone AG, Berlin	U3M	1,800	Metal/cable branch boxes, digital displays, etc.	Trade directory	Plant engineer responsible for preparing plant maintenance work and for waste disposal (3a), safety engineer (3b)	IIA IIA
Siemens Rohrenwerk, Berlin	U4M	800	Metal/communications technology consumer electronics	Experts	Staff post incumbent industrial safety/environmental protection, volunt. environmental manager (4a), electroplater responsible in practice for waste disposal (4b)	IA IIB/ IIA
Spinnstoff-Fabrik Zehlendorf AG, Berlin	U5M	340	Chemical/polyester chemical fibres	Experts	Head of laboratory and volunt. environmental manager (5a), safety foreman responsible in practice for waste disposal (5b)	IIA IIA IIA
Schempp & Decker, Industriegalvanik, GmbH & Co. KG, Berlin	U6M	180	Metal/electroplating	Trade directory	Deputy head technical service and volunt. environmental manager (6a), electroplater acting as water supply/sewage disposal technician (6b)	IIA IIB
Knipex KG, Wuppertal	U7M	620	Metal/pliers, pincers	Chamber of industry and trade	Specialist in maintenance, lay-out planning and materials flow planning, volunt. environmental manager (7)	IIA
FAG Kugel-Fischer, Wuppertal plant	U8M	2,500	Metal/roller bearings	Chamber of industry and trade	Group leader supply and disposal, plant clean air manager (8a), waste treatment plant operator and water supply/sewage disposal technician (8b)	IIA IIB
Happich GmbH, Wuppertal plant	U9C	2,900	Metal and chemical/ car accessories	Chamber of industry and trade	Plant clean air manager in staff post (9a), waste treatment plant foreman (9b)	IA IIB
Follmann & Co. KG, Minden	U10C	150	Chemical/ printing inks, adhesives, chemicals for building industry, etc.	IÖW Berlin and contacts with Förderkreis Ögwelt "future"	Volunt. and statutory environmental manager in staff unit (10a), chemical laboratory assistant in staff post post (10b), chemical laboratory assistant (10c)	IA IB IIB
Quante AG, Wuppertal plant	U11M	1,500	Metal/telephone booths, measuring instruments, etc.	IÖW Wuppertal	Development engineer and member of "waste" working group (11)	IIA
Bayer AG, Leverkusen plant	U12C	30,000	Chemical/wide range of products	IÖW Berlin, inquiry report	Hour-long telephone interview with head of dept. for further training and information on environmental protection (12)	IA

Annex 2: Interview guide "New occupational and qualification structures in the field of environmental protection"

1. General information on the firm or plant (main products and production processes, number of employees, general environmental problems, state of the art)

2. The role of environmental protection in the firm, organization of environmental protection

a) Is there any specific written information on the subject (models, environmental report, etc.)?

b) What view if taken of environmental protection in the firm? (since when has it been considered, actively vs passively, end-of-pipe vs integration, reasons for need for action (market, regulations, etc.), products and processes challenged)

c) How is environmental protection organized? (staff posts, central department, environmental manager, safety engineers, responsible managing board member)

3. Can you give us a general picture of environmental protection functions in your firm? Our three-part typology should be taken as a basis (I, IIA, IIB). (Which functions are most common?)

a) Examples of "environmental professionals" (I) (e.g. water supply and waste disposal technician; environmental protection engineer)

b) Examples of environmental protection as a significant additional task or specific responsibility alongside other tasks (IIA) (e.g. plant engineer who also acts as plant manager responsible for the protection of water against pollution; works council member responsible for environmental protection; skilled worker also responsible for waste disposal)

c) Examples of environmental protection as integral part of performance of tasks (IIB) (e.g. environmental impact testing of equipment by plant engineer; assessment pursuant to Chemical Substances Act by chemist in laboratory; unit operator required to watch out for faults; product marketer; appropriate handling of dangerous substances)

4. The object in the following is to obtain a more accurate description of one or more functions, applying the following criteria:

a) designation of the activity

b) time when function emerged

c) hierarchical position; responsibility (management vs implementation); authority to issue instructions

d) (core) tasks

e) existing competences

f) formal training requirements; initial and continuing training relating to the environment

g) access, certificate/title, legal basis, arrangement between two sides of industry

5. Assessment of future occupational and qualification structures in the field of environmental protection

a) How do you rate the quality of the products (inputs) purchased by your firm? Are new tasks emerging in this respect?

b) How do you rate the possibility of giving the users of your products not only sales advice but also advice relating to the environment?

c) Where else do you see environmental protection requirements emerging, and what form will they take?

6. Also to be specified or possibly (if known) details obtained on a function when interviewing employees responsible for environmental protection: precisely what form does the activity take?

Re c) Tasks

- subject/content/purpose/objectives (Which aspects of the environment? Which substances? Relevant legislation, internal instructions)

- means of solving problems (financial resources, technical equipment, etc.; means of obtaining information on the environment; see also cooperation)

- assignment to functional area in the firm or phase of the internal product life cycle (e.g. R&D, work scheduling, manufacture, assembly, maintenance, quality control, storage, disposal or procurement, organization, training, marketing)

- process stage (planning, implementation, monitoring)

- scope for action relating to the environment (opportunities for acting to the benefit or detriment of the environment; level of routine or diversity; opportunities for action in case of conflict)

- time devoted to environmental protection (hours per week)

- cooperation - horizontal: internal, external partners; form of cooperation (project, service, etc.)

- cooperation - vertical: relationship between superiors and subordinates

Re d) Competences in CEDEFOP terminology - interpreted ecologically

- "qualifications": knowledge of environmental problems associated with own and firm's activities, of relevant standards, of measures

to be taken; interdisciplinary knowledge; general environmental education, awareness

- "competences": practical know-how, abilities, skills for the achievement of environmental protection objectives

- "social requirements; attitudes": ethical attitude; sensory experience and creative ability; motivation; assertiveness and ability to work as part of a team

Re e) Initial and continuing training relating to the environment

- place (school, firm, continuing training body, etc.)

- nature of training (content, cost, formal certificate, composition of class, duration, frequency, teaching methods (lectures, projects, excursions, etc.))

Annex 3: Interviews with scientific experts

on environmental protection in the chemical industry:

Stefan Longolius
Centre for Research on the Social Economics of Work, Free University of Berlin

Andreas Kraemer
Centre for Research on Environmental Policy, Free University of Berlin

on training and environmental protection in the scientific occupations:

Dr Volker Paul
Federal Institute for Vocational Training, Berlin

on environmental problems in the metal industry:

Mrs Eckhardt
Environmental Adviser of the Chamber of Industry and Trade, Ulm
at the time of a lecture given at the conference "The Environment ABC of Vocational Training", 3-5 May 1990, Evangelische Akademie, Bad Boll

Supplementary telephone interviews:

on environmental protection in the metal industry:

Dr Fresenius
Battelle Institute, Frankfurt

on environmental managers:

Klaus Mattenklott
Association of Environmental Plant Managers, Essen

on water supply and waste disposal technicians:

Professor Ernst Uhe
Department of Educational Science, University of Hamburg

on training content, qualifications and occupational fields at selected training bodies:

Rhenish Academy, Cologne
- biological technical assistant
- chemical technical assistant

College of Technology, Landau
- environmental technical assistant

Technical University of Berlin
- course in environmental technology

Bavarian Factory Inspectorate, Nuremberg
- waste water treatment in metal-processing firms

Rhineland Academy of the Trade Cooperative Association, Wuppertal
- training to become a water supply and waste disposal technician

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Occupational and qualification structures in the field of environmental protection in the metal and chemical industries - Study on the Federal Republic of Germany

by Christoph Nitschke and Ulrich Schumann
assisted by Michael Skoppek

CEDEFOP Document

Luxembourg: Office for Official Publications of the European Communities

1991 — V, 57 pp. — 21.0 x 29.7 cm

ISBN 92-826-2015-8

Catalogue number: HX-60-90-313-EN-C

Price (excluding VAT) in Luxembourg: ECU 7

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Tel.: (0 30) 88 41 20; Telefax: 88 41 22 22; Telex: 184 163 eucen d

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